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State of New York — Department of Agriculture.

TWELFTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

NEW YORK

Agricultural Experiment Station,

(GENEVA, ONTARIO COUNTY.)

FOR THE YEAR 1893,

WITH REPORTS OF DIRECTOR AND OTHER OFFICERS.

TRANSMITTED TO THE LEGISLATURE APRIL 26, 1894

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STATE OF NEW YORK.

No. 93.

IN ASSEMBLY,

April 26, 1894.

TWELFTH ANNUAL REPORT

OF THE

Board of Control of the New York Agricultural Experiment Station.

STATE OF NEW YORK:

Department of Agriculture,
Albany, *April* 26, 1894.

To the Assembly of the State of New York:

I have the honor to herewith transmit the Twelfth Annual Report of the Director and Board of Managers of the New York Agricultural Experiment Station at Geneva.

I am respectfully,
FRED. C. SCHRAUB,
Commissioner of Agriculture.

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1893.

ORGANIZATION OF THE STATION.

BOARD OF CONTROL.

ROSWELL P. FLOWER, *Governor*,	Albany.
W. C. BARRY, *President*	Rochester, Monroe County.
CHARLES JONES	Geneseo, Livingston County.
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WILLIAM D. BARNS	Middle Hope, Orange County.
MARTIN VAN BUREN IVES	Potsdam, St. Lawrence County.
LUMAN D. OLNEY	Watertown, Jefferson County.

STATION OFFICERS.

Director	Dr. Peter Collier.
First Assistant	Wm. P. Wheeler.
Horticulturist	S. A. Beach, M. S.
Assistant Horticulturist	Wendell Paddock, B. S.
Chemist	L. L. Van Slyke, Ph. D.
Assistant Chemist	C. G. Jenter, Ph. C.
Assistant Chemist	A. L. Knisely, B. S.
Assistant Chemist	W. B. Cady, Ph. C.
Assistant Chemist	* B. L. Murray, Ph. C.
Assistant Chemist	* A. D. Cook, Ph. C.
Agriculturist	George W. Churchill.
Clerk and Stenographer	Frank E. Newton.

Post-office address: Geneva, Ontario County, N. Y.

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* Connected with Fertilizer Control.

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TWELFTH ANNUAL REPORT

OF THE

Board of Control of the New York State Agricultural Experiment Station.

TREASURER'S REPORT.

To the Board of Control of the New York Agricultural Experiment Station:

As treasurer of the Board of Control, I do respectfully report :

That I have received from the Treasurer of the State of New York, for the twelve months ending September 30, 1893	$40,000 00
That the balance on hand September 30, 1892, was,	16 22
Total	$40,016 22

And I do further report that I have expended during the twelve months ending September 30, 1893, $38,429.48, vouchers for which, duly audited by the special auditing committee of the Board of Control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditure has been as follows:

Farm and grounds	$3,059 31
Freight, cartage and express	417 05
Fuel and light	1,303 18
Furniture	175 25
Labor	12,964 20
Laboratory department	549 46
Library	194 70
Live stock	123 45

Postage expenses	$263 00
Repairs	1,087 94
Salaries	13,313 22
Scientific apparatus	2 75
Scientific supplies	267 92
Stationery	100 27
Sundries	43 99
Supplies	3,245 80
Travel	283 88
Board of Control, expenses of	511 94
Rent (tenement house)	300 00
Telephone and telegraph	8 67
Insurance	23 75
Water rent	189 75
	$38,429 48
Balance on hand	1,586 74
Total	$40,016 22

And I do further report that I have received from the Treasurer of the State of New York on account of "expense of bulletins and enforcing provisions of chapter 437, Laws of 1890," for the twelve months ending September 30, 1893	$10,000 00
That the balance on hand September 30, 1892, was,	2,608 84
Total	$12,608 84

And I do further report that I have expended on this account $10,941.73, vouchers for which, duly audited by the special auditing committee of the Board of Control, have been presented the Comptroller of the State of New York. Properly classified, the expenditure has been as follows:

Freight, cartage and express	$18 00
Gas	423 30
Insurance	20 25
Bulletins and printing	3,697 85
Postage	975 70

Plumbing	$52 00
Rent	112 50
Salaries	2,019 78
Supplies	2,268 45
Securing samples	1,106 47
Sundries	24 41
Water rent	193 82
Fixtures	17 00
Repairs	12 20
	$10,941 73
Balance on hand	1,667 11
Total	$12,608 84

And I do further report that the balance on hand September 30, 1892, of a special appropriation of $6,000 for completion of laboratory was $1,726.74; that I have expended on this account for the year ending September 30, 1893	$1,726 31
Balance on hand	43
	$1,726 74

Properly classified, the expenditure has been as follows:

Carpentry	$84 35
Materials	387 19
Masonry	15 33
Plumbing	1,239 44
Total	$1,726 31

And I do further report that I have received from the Treasurer of the State of New York a special appropriation of $2,000 for cold-storage house, and that I have expended on this account	$1,931 38
Balance on hand	68 62
Total	$2,000 00

Properly classified, the expenditure has been as follows:

Labor	$609 58
Masonry	106 80
Materials	15 00
Wicks Refrigerator Company (contract)	1,200 00
Total	$1,931 38

And I do further report that I have received from the Treasurer of the State of New York $500, special appropriation for ice-house, and I have expended on this account for materials and labor,	$496 52
Balance on hand	3 48
Total	$500 00

Vouchers for the expenditure of these special appropriations have been duly audited by the special auditing committee of the Board of Control, and have been furnished the Comptroller of the State of New York.

WILLIAM O'HANLON,
Treasurer.

REPORT OF THE DIRECTOR.

PETER COLLIER, A. M., M. D., Ph. D.

To the Board of Control of the New York Agricultural Experiment Station:

GENTLEMEN.—I submit herewith the twelfth annual report of the experiment station for the calendar year 1893.

During the past year the executive committee of the Board of Control have continued their meetings at the station, at which meetings the detailed monthly statements of the several members of the staff have been submitted by the director for consideration, also a brief statement of the work of the coming month and necessary expenses to be incurred.

At such meetings also the treasurer has furnished a statement of the expenditures and the balances remaining of the several appropriations for the station, general and special, so that through their committee the Board of Control have been constantly advised of the nature and progress of the work being carried forward by each member of the staff and of the labor force employed. The auditing committee of the Board of Control have met as usual the first Friday of each month.

During the past year among the permanent improvements to be mentioned are:

1. A new forcing house, for which a special appropriation of $5,000 was made by the Legislature, has been erected. This house was built by Lord & Burnham, of Irvington, N. Y., and is of the following dimensions: office, 25 by 15 feet; main house, 60 by 20 feet, with two wings, each 44 by 20 feet. Coal and boiler room of brick under the office.

It is substantially built with iron frames; is heated with hot water and has been given up to the growing of forced vegetables, cucumbers, tomatoes, lettuce, beans, radishes, strawberries and mushrooms, and has already proved of great interest to those who are searching for new and more profitable industries.

2. By means of a deep trench upon the north side, extending below the basement of the cold-storage building, a series of tile drains have been laid for removing the soil water which had no other escape, and by which it is hoped the storage rooms may be kept dry.

3. The room in the station building once devoted to the chemical laboratory has been entirely refitted with new walls, ceiling and floor and appropriated as an office room for the first assistant and stenographer.

4. A hot air forcing pump has been placed in the basement of the new laboratory for the purpose of raising water from the cistern or street main to the tank in the top of the building, and for such purpose has proved entirely successful.

5. The new ice pond has been enlarged and its banks strongly reinforced to avoid any danger from breaking away. The pond has been stocked with carp received from the United States Fish Commission at Washington, D. C. The western half of the creek running through the farm has been straightened, the channel deepened and the banks straightened in order that in future its course may be kept within proper bounds.

6. Five gas street lamps for lighting the grounds of the station and two hydrants for supplying water in case of fire have been connected with the street mains. Three stiles for crossing the wire fences have been placed in position.

7. Graveled driveways have been built from the rear of the new laboratory and the lawn extended to the road through the orchard.

8. New tile drains have been laid through the orchards and the plats, providing proper drainage for this portion of the farm.

9. Floors have been relaid in some of the cattle stalls and pig-pens; the furnace, seed and storage rooms in the main building have been refloored and painted, and two of the poultry houses have been relined with paper. Some necessary repairs have been made to the fountains and roadways about the grounds and cattle yards.

From the above brief résumé of the work of the station in the line of permanent improvement and necessary repairs it will be seen that much has to be done which cannot well be foreseen in order to simply maintain the building and grounds of the station in a proper condition.

The report of the treasurer presents an itemized account of the receipts and expenditures of the station during the last fiscal year.

Bulletins Published During the Year 1893.

The following is a list of subjects presented in the fifteen bulletins published and distributed by the station during the year. The aggregate number of pages in these bulletins is 695, and of each an edition generally of 15,000 copies has been distributed.

In addition to the bulletins three circulars have been published upon "The Leaf Spot of Chrysanthemums," "Preserving Eggs," and "The Fertilizer Law" of the State.

Bulletin No. 49, January, pp. 16.— I. Treatment of Potato Scab; II. Use of Bordeaux Mixture for Potato Blight.

Bulletin No. 50, January, pp. 116.— Summary of Results of Experiments Made in Manufacture of Cheese During the Season of 1892.

Bulletin No. 51, March, pp. 16.— Some Celery Diseases.

Bulletin No. 52, March, pp. 43.— Analyses of Commercial Fertilizers.

Bulletin No. 53, April, pp. 33.— Feeding Experiments with Capons; Cost of Production; Capons and Cockerels Compared; Rations containing Different Proportions of Protein; General Observations.

Bulletin No. 54, May, pp. 43.— Experiments in the Manufacture of Cheese; Part I. Manufacture of Cheese from Normal Milk, Rich in Fat; Part II. Study of the Cheese Ripening Process.

Bulletin No. 55, May, pp. 89.— General Principles Relating to the Composition and Use of Fertilizers.

Bulletin No. 56, May, pp. 33.— Experiments in the Manufacture of Cheese; Part I. The Manufacture of Edam Cheese; Part II. The Manufacture of Gouda Cheese.

Bulletin No. 57, June, pp. 13.—Feeding Experiments with Laying Hens; Keeping Males with the Laying Stock; Observations on Feather Eating; General Observations.

Bulletin No. 58, July, pp. 13.—Analyses of Commercial Fertilizers Collected on Long Island in the Spring of 1893.

Bulletin No. 59, September, pp. 35.—Analyses of Commercial Fertilizers Collected in the Spring of 1893.

Bulletin No. 60, October, pp. 66.—Investigations Relating to the Manufacture of Cheese; Part I. Results of Work Done in the No. 1 Factory of E. L. Stone at Mannsville, Jefferson County during the Season of 1893.

Bulletin No. 61, November, pp. 62.—Investigations Relating to the Manufacture of Cheese; Part II. Results of Work done in the Factory of G. Merry at Verona, Oneida County, during the Season of 1893.

Bulletin No. 62, December, pp. 77.—Investigations Relating to the Manufacture of Cheese; Part III. Results of Work done during the Season of 1893 in Forty-eight Different Factories located in Eight Counties.

Bulletin No. 63, December, pp. 27.—Some Experiences with Blackberries, Dewberries and Raspberries.

During the year many of the investigations which have been carried on at the station have been continued, and several new experiments have been undertaken, which may be summarized as follows:

Investigation of the Several Breeds of Dairy Cattle.

This investigation has been continued mainly with a view to determine the relative value of the different breeds in the production of milk, butter and cheese, and in connection with this a careful study of the differences in the composition and quality of the milk produced.

Experiments with Poultry and Swine.

1. Continuation of breeding experiment with laying hens.
2. Cost of growing chicks with hens.
3. Feeding experiments with capons.
4. Feeding experiments with pigs, wet food and dry food being contrasted.

5. Feeding experiments with pigs of different breeds.
6. Feeding trial with whole corn contrasted with corn meal.
7. Continuation of field experiments with crude chemicals.

Chemistry.

1. Experiments relating to the manufacture of Edam and Gouda cheese.
2. The use of the hygrometer in cheese-curing rooms.
3. Study of the cheese-ripening process.
4. Experiments relating to the manufacture of cheese from normal milk rich in fat.
5. Investigation relating to the manufacture of cheese in cheese factories during the season of 1893.
6. A study of the composition of milk, whey and cheese.
7. Loss of milk constituents in cheese-making.
8. Relation of composition of milk to yield of cheese.
9. The determination of casein in cows' milk.
10. Analyses of commercial fertilizers collected in New York State during the spring and fall of 1893.

Horticulture.

1. Report of work with vegetables.
2. Report on varieties of small fruits, grapes, stone fruits and pomaceous fruits.
3. Report on work in crossing strawberries.
4. Experiments in prevention of pear scab.
5. Observations on infection of plum trees with black knot.
6. Treatment of plum nursery stock for leaf blight.
7. Investigations of celery diseases.
8. Experiments in potash fertilization of grapes.
9. Experiments on potato scab.

For details concerning the above work and the results obtained in the several investigations reference is made to the body of this report.

The Investigation of the Several Breeds of Dairy Cattle with Reference to their Relative Value in the Production of Milk, Butter and Cheese.

In reference to this important investigation, I can but repeat the words of a former report:

The investigation of this problem planned at this station has from the first been upon lines clearly laid down, confident that in no other way can a satisfactory conclusion be reached, and it is along these lines that it is intended to continue until an accumulation of testimony shall have been secured sufficient to reconcile many at present apparently conflicting opinions, to confirm many others which appear to be conclusive, as also to determine many questions intimately associated with the leading problems concerning which at present no rule of practice exists, founded upon well ascertained experimental data.

Of such immense practical importance is this investigation and of such scientific interest that it has been entered upon and carried forward with as little delay as possible, and so manifold and intricate are the questions involved in its discussion that a speedy conclusion of the whole matter can only be hoped for as the result of prolonged investigation.

In the following pages is presented additional data secured since the publication of the last report, a general discussion of which will be reserved until it has been presented.

The following table gives the names of the several animals under investigation, their breed, date of birth and dates of calving.

TABLE 1.

NAMES AND BREEDS OF COWS UNDER INVESTIGATION.

Dates of Birth and of Calving.

NAME OF COW.	When born.	Date of calving, first period of lactation.	Date of calving, second period of lactation.	Date of calving, third period of lactation.	Date of calving, fourth period of lactation.
Ayrshires.					
Queen Duchess	Feb. 21, 1888	July 24, 1890	Nov. 24, 1891	Dec. 6, 1892	....
Junietta Peerless	July 26, 1888	Feb. 4, 1891	May 2, 1892	May 5, 1893	....
Manton Belle	June 16, 1888	Dec. 11, 1890	Dec. 29, 1891	Nov. 21, 1892	Dec. 12, 1893
Miss Flow 5th	March 1, 1888	Feb. 5, 1890	Feb. 18, 1891	May 6, 1892	April 20, 1893
Jerseys.					
Gilderbloom	April 6, 1888	Sept. 9, 1890	Feb. 29, 1892	April 13, 1893	....
Countess Flavia	May 14, 1888	April 19, 1890	Nov. 14, 1891	Nov. 12, 1892	Nov. 4, 1893
Barbara Allen	Aug. 18, 1888	Aug. 29, 1890	April 11, 1882	May 4, 1893	....
Albert's Carol	Jan. 12, 1890	March 26, 1892	Oct. 31, 1893	....	....
American Holderness.					
Nellie 6th	Aug. 10, 1888	Sept. 13, 1890	Nov. 26, 1891	Dec. 12, 1892	....
Maggie 6th	Aug. 15, 1888	Sept. 25, 1890	May 17, 1892	May 13, 1893	....
Nora	Sept. 25, 1890	Dec. 17, 1893	....	....	....
Guernseys.					
Rosette Ford	May 10, 1888	Nov. 14, 1890	Jan. 30, 1893	....	....
Oriole	Aug. 25, 1888	Dec. 7, 1890	Dec. 8, 1892	....	....
Stella Select	Dec. 8, 1889	Feb. 13, 1892	May 29, 1893	....	....
Madam Select	March 3, 1889	Dec 8, 1891	Oct. 13, 1892	....	....

TABLE 1. NAMES AND BREEDS OF COWS UNDER INVESTIGATION — (*Concluded*).

NAME OF COW.	When born.	Date of calving, first period of lactation.	Date of calving second period of lactation	Date of calving, third period of lactation.	Date of calving, fourth period of lactation.
Devons.					
Ione	March 5, 1888	March 7, 1891	June 30, 1892	June 2, 1893	....
Genevie's Gift	Sept. 19, 1889	May 15, 1891	Oct. 30, 1892	....	....
Artalia	Jan. 12, 1889	Dec. 24, 1891	June 26, 1893	....	....
Day Dream B	....	April 29, 1893	....	....	....
Holstein-Friesian.					
Esel 2nd	June 22, 1888	July 16, 1890	Aug. 28, 1892	....	....
Tolsma Artis	April 2, 1888	May 24, 1890	May 23, 1891	Aug. 4, 1892	Sept. 21, 1893
Netherland Constance	July 17, 1890	Oct. 13, 1892	....	....	....
Beauty Pledge	March 20, 1890	April 5, 1892	Dec 10, 1893	....	....
Ruth	May 23, 1891	Dec. 4, 1893	....	....	....
Short-horns.					
Betsey 10th	Nov. 18, 1889	May 5, 1892	Nov. 25, 1893	....	....
Lady Spencer	Jan. 9, 1890	Oct. 18, 1892	....	....	....

Quality and Quantity of Food Fed.

The following table, which is a continuation of similar tables in the tenth and eleventh annual reports, gives the kind and amount of each food eaten by each animal during each month of the experiment, and it will serve as a guide to those who may desire, during the different months of the year, to supply their animals with a similar ration.

Letters of inquiry are frequently addressed to the station asking for information as to the rations needed for production of the best results, a question of the greatest practical importance to the dairyman, but yet one concerning which I think the correct answer remains largely for future determination, but by consulting the following table one may learn what ration was fed the several animals of our herd each month in the year, and by comparing with other tables presented in this report the effect of such feed, as also of the changes from one kind of feed to another, may be determined, and the knowledge thus obtained is sure to be of interest and may be of great value by way of suggesting certain experiments indicated by the results here recorded. As is well known to the practical feeder, very marked differences are found to result from simply a change of feed without regard to the difference in composition of such feed, and the following pages will record many such changes made with our herd and the results presumably produced thereby.

FOOD FED COWS DURING EXPERIMENTS.

TABLE 2. *First period of lactation, continued from Eleventh Annual Report.*

	COW.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1892.						
December ...	Netherland Constance	215.6	668.9	....	780.0	309.0
December ...	Beauty Pledge	179.8	711.3	....	780.0	246.0
December ...	Albert's Carol	150.0	564.3	....	570.0	247.0
December ...	Stella Select	172.9	720.0	....	728.0	239.0
December ...	Betsy 10th	180.9	720.0	....	728.0	300.0
December ...	Lady Spencer	243.0	792.0	....	780.0	309.0
December ...	Artalia	167.8	720.0	....	728.0	207.0
1893.						
January	Netherland Constance	311.0	713.4	....	....	310.0
January	Beauty Pledge	335.9	774.8	....	....	182.0
January	Albert's Carol	277.9	619.2	....	....	217.0
January	Stella Select	306.9	682.0	....	....	199.0
January	Betsy 10th	347.1	774.7	....	....	276.0
January	Lady Spencer	426.5	774.9	....	....	307.0
January	Artalia	303.8	681.4	....	....	169.0
February ...	Netherland Constance	327.1	622.8	....	....	280.0
February ...	Beauty Pledge	335.1	700.0	....	....	168.0
February ...	Albert's Carol	246.8	558.4	....	....	196.0
February ...	Stella Select	279.9	616.0	....	....	168.0
February ...	Betsy 10th	326.6	698.8	....	....	224.0
February ...	Lady Spencer	388.3	700.0	....	....	252.0
February ...	Artalia	280.0	616.0	....	....	121.0

March	Netherland Constance	367.6	681.3	....	....	310.0
March	Beauty Pledge	372.0	775.0	....	....	186.0
March	Albert's Carol	272.2	620.0	....	....	217.0
March	Stella Select	309.7	682.0	....	....	104.5
March	Betsy 10th	360.3	770.7	....	....	248.0
March	Lady Spencer	431.9	775.0	....	....	279.0
March	Artalia	309.5	681.8	....	....	103.0
April	Netherland Constance	205.5	1049.8	....	....	300.0
April	Beauty Pledge	209.9	1200.0	....	....	180.0
April	Albert's Carol	138.0	903.9	....	....	210.0
April	Stella Select	300.0	255.0	....	225.0	....
April	Betsy 10th	201.4	1078.8	....	....	239.4
April	Lady Spencer	238.8	1200.0	....	....	269.9
April	Artalia	299.7	599.5	....	....	66.0
April	Day Dream B	6.1	14.7	....	8.0	....
May	Netherland Constance	207.9	917.3	....	....	255.8
May	Beauty Pledge	217.0	1339.8	....	....	186.0
May	Albert's Carol	130.0	888.9	....	....	217.0
May	Betsy 10th	208.5	1093.7	....	....	247.9
May	Lady Spencer	244.9	1240.0	....	....	249.4
May	Day Dream B	105.2	503.9	....	....	48.0
June	Netherland Constance	195.5	....	1359.7	....	240.3
June	Beauty Pledge	194.7	....	1405.6	....	174.0
June	Albert's Carol	134.9	....	996.5	....	174.5
June	Betsy 10th	180.1	....	1280.1	....	171.3
June	Lady Spencer	193.9	....	1396.5	....	162.5
June	Day Dream B	118.9	....	1093.0	....	89.9
July	Netherland Constance	171.3	....	1707.1	....	237.7
July	Beauty Pledge	186.0	....	1721.6	....	155.0
July	Albert's Carol	123.0	....	1219.2	....	162.5
July	Betsy 10th	152.9	....	1625.1	....	157.3

TABLE 2. FOOD FED COWS DURING EXPERIMENTS — (*Concluded*).

	COW.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1893.						
July	Lady Spencer	176.3	....	1674.3	....	155.9
July	Day Dream B	122.1	....	1317.9	....	123.9
August	Netherland Constance	452.9	....	511.0	....	215.7
August	Beauty Pledge	452.0	....	446.9	....	139.5
August	Albert's Carol	333.1	....	424.0	....	139.0
August	Betsy 10th	400.7	....	503.9	....	140.4
August	Lady Spencer	400.0	....	506.0	....	147.0
August	Day Dream B	329.5	....	419.0	....	70.0
September	Netherland Constance	177.8	....	1642.8	....	177.3
September	Beauty Pledge	179.0	....	1410.0	....	90.0
September	Albert's Carol	142.7	....	1271.2	....	43.0
September	Betsy 10th	174.0	....	1632.3	....	76.9
September	Lady Spencer	179.7	....	1641.7	....	105.0
September	Day Dream B	145.0	....	1388.6	....	118.4
October	Netherland Constance	182.1	....	1036.9	524.4	169.1
October	Albert's Carol	107.1	....	642.5	....	....
October	Beauty Pledge	186.0	....	939.0	489.0	52.5
October	Lady Spencer	185.0	....	1090.6	629.9	108.3
October	Day Dream B	144.4	....	753.4	510.0	123.3
November	Netherland Constance	178.7	1251.5	....	....	160.0
November	Lady Spencer	179.9	1366.2	....	....	105.0
November	Day Dream B	100.2	1171.0	....	....	120.0

FOOD FED COWS DURING EXPERIMENTS.

TABLE 3. *Second period of lactation, continued from Eleventh Annual Report.*

	COW.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1892.						
December ...	Esel 2nd	241.3	898.7	....	884.0	340.0
December ...	Junietta Peerless	194.2	726.6	....	780.0	246.0
December ...	Gilderbloom	153.3	647.6	....	676.0	177.0
December ...	Barbara Allen	167.8	647.9	....	728.0	239.0
December ...	Maggie 6th	153.1	704.6	....	728.0	269.0
December ...	Oriole	130.4	629.0	....	36.0	94.7
December ...	Madam Select	167.6	718.2	....	728 0	269.0
December ...	Ione	167.0	570.6	....	676.0	269.0
December ...	Genevie's Gift	126.0	560.5	....	676.0	207.5
1893.						
January	Esel 2nd	420.3	929.3	....	....	305.5
January	Junietta Peerless	353.1	674.0	....	....	176.5
January	Gilderbloom	278.0	618.9	....	....	138.0
January	Barbara Allen	306.0	615.8	....	....	217.0
January	Maggie 6th	269.3	678.9	....	....	248.0
January	Oriole	345.6	773.5	....	....	258.0
January	Madam Select	303.2	682.0	....	....	248.0
January	Ione	290.2	557.2	....	....	226.5
January	Genevie's Gift	239.9	556.5	....	....	186.0
February ...	Esel 2nd	382.8	839.3	....	....	252.0
February ...	Junietta Peerless	335.9	616.0	....	....	127.0
February ...	Gilderbloom	250.8	560.0	....	....	124.0

TABLE 3. FOOD FED COWS DURING EXPERIMENTS — (*Continued*).

	COW.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1893.						
February ...	Barbara Allen	280.0	560.0	....	....	188.5
February ...	Maggie 6th	230.1	549.3	....	....	192.5
February ...	Rosette Ford	255.7	523.4	....	....	107.0
February ...	Oriole	333.9	760.0	....	....	253.5
February ...	Madam Select	275.2	616.0	....	....	198.5
February ...	Ione	270.7	502.5	....	....	127.0
February ...	Genevie's Gift	219.8	487.9	....	....	168.0
March	Esel 2nd	394.6	927.5	....	....	279.0
March	Junietta Peerless	371.9	682.0	....	....	37.5
March	Gilderbloom	277.8	619.8	....	....	31.5
March	Barbara Allen	310.0	620.0	....	....	104.0
March	Maggie 6th	246.7	669.4	....	....	71.0
March	Rosette Ford	307.4	680.4	....	....	271.0
March	Oriole	366.4	775.0	....	....	257.1
March	Madam Select	305.4	682.0	....	....	217.0
March	Ione	303.2	557.7	....	....	58.0
March	Genevie's Gift	243.0	494.6	....	....	186.0
April	Esel 2nd	226.9	1390.1	....	....	269.9
April	Barbara Allen	90.0	180.0	....	....	....
April	Rosette Ford	191.1	1200.0	....	....	291.7
April	Oriole	189.0	1196.2	....	....	209.5
April	Madam Select	170.1	1197.4	....	....	194.3
April	Genevie's Gift	147.0	843.0	....	....	180.0
April	Ione	130.4	280.0	....	....	....

May	Esel 2nd	232.9	1287.3	....	....	278.7
May	Rosette Ford	185.6	1189.9	....	....	298.0
May	Oriole	175.1	1220.3	....	....	215.7
May	Stella Select	24.0	....	....	37.0	6.5
May	Madam Select	166.1	1144.4	....	....	185.6
May	Genevie's Gift	153.7	817.4	....	....	186.0
June	Esel 2nd	190.4	....	1380.0	....	213.1
June	Rosette Ford	168.0	....	1437.3	....	277.0
June	Oriole	165.8	....	1368.8	....	187.0
June	Stella Select	159.9	....	1337.4	....	123.0
June	Madam Select	159.4	....	1286.0	....	147.4
June	Genevie's Gift	120.8	....	1074.1	....	159.5
June	Artalia	38.1	....	....	116.0	15.0
July	Esel 2nd	183.6	....	1743.5	....	169.3
July	Rosette Ford	152.9	....	1774.0	....	273.0
July	Oriole	145.7	....	1646.0	....	195.7
July	Stella Select	155.0	....	1723.0	....	248.0
July	Madam Select	152.9	....	1481.6	....	162.0
July	Genevie's Gift	123.9	....	1329.2	....	124.0
July	Artalia	154.8	....	1415.6	....	173.3
August	Esel 2nd	455.5	....	451.2	....	154.9
August	Rosette Ford	371.3	....	2027.2	....	385.0
August	Oriole	384.4	....	475.7	....	197.6
August	Stella Select	427.0	....	492.3	....	274.0
August	Madam Select	365.8	....	383.4	....	139.0
August	Genevie's Gift	328.5	....	422.4	....	95.5
August	Artalia	370.4	....	471.7	....	212.0
September	Esel 2nd	161.4	....	1312.3	....	113.8
September	Rosette Ford	179.6	....	1600.3	....	240.0
September	Oriole	157.9	....	1571.9	....	137.8
September	Stella Select	179.2	....	1649.7	....	255.0

TABLE 3. FOOD FED COWS DURING EXPERIMENTS — (*Concluded*).

	COW.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1893.						
September ..	Madam Select	146.4	....	1328.1	....	57.0
September ..	Artalia	147.9	....	1584.3	....	194.6
October.....	Rosette Ford	185.2	....	1117.0	630.0	248.0
October.....	Oriole	157.5	....	1025.8	165.4	139.8
October.....	Stella Select	185.7	....	1118.1	630.0	263.5
October.....	Madam Select	65.5	....	311.0	....	....
October.....	Artalia	150.5	....	1074.7	629.0	206.0
November...	Albert's Carol	132.2	451.5	....	455.6	60.0
November...	Rosette Ford	178.7	1455.3	....	....	230.0
November...	Oriole	143.6	1317.2	....	....	158.7
November...	Stella Select	175.0	1396.7	....	....	207.2
November...	Artalia	146.8	1288.6	....	....	199.9
November...	Betsy 10th	32.5	34.0	....	68.0	19.1

Food Fed Cows During Experiments.

TABLE 4. *Third period of lactation, continued from Eleventh Annual Report.*

	COW.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1892.						
December ...	Miss Flow 5th	198.7	718.0	....	780.0	269.0
December ...	Tolsma Artis	241.3	900.0	....	884.0	310.0
December ...	Countess Flavia	167.6	570.3	....	728.0	262.5
December ...	Manton Belle	226.0	787.8	....	832.0	302.0
December ...	Nellie 6th	32.8	546.5	....	16.0	83.5
1893.						
January	Miss Flow 5th	353.0	664.4	....	....	219.5
January	Tolsma Artis	403.9	930.0	....	....	296.8
January	Countess Flavia	306.7	649.1	....	....	248.0
January	Manton Belle	422.0	851.3	....	....	325.0
January	Nellie 6th	131.6	613.9	....	....	258.0
February ...	Miss Flow 5th	326.5	507.3	....	....	127.0
February ...	Tolsma Artis	365.6	840.0	....	....	161.7
February ...	Countess Flavia	279.6	558.3	....	....	248.0
February ...	Manton Belle	388.1	697.1	....	....	203.4
February ...	Nellie 6th	71.6	451.9	....	....	129.1
March	Miss Flow 5th	223.9	335.1	....	....	27.5
March	Tolsma Artis	403.1	930.0	....	....	151.6
March	Countess Flavia	309.2	612.3	....	....	248.0
March	Manton Belle	433.6	774.9	....	....	248.0
March	Nellie 6th	131.6	480.5	....	....	248.0

TABLE 4. FOOD FED COWS DURING EXPERIMENTS — (*Continued*).

	COW.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1893.						
April	Tolsma Artis	234.4	1498.5			148.2
April	Gilderbloom	90.4	260.7		93.0	56.5
April	Countess Flavia	179.3	1065.1			240.0
April	Manton Belle	240.0	1331.6			271.5
April	Nellie 6th	84.8	767.5			239.9
May	Tolsma Artis	244.1	1549.5			169.8
May	Gilderbloom	145.1	1083.6			139.5
May	Countess Flavia	172.5	943.5			219.0
May	Barbara Allen	183.5	679.3		98.0	105.0
May	Manton Belle	247.0	1292.7			277.3
May	Junietta Peerless	174.8	687.9		73.0	99.5
May	Nellie 6th	104.6	597.9			194.3
May	Maggie 6th	135.2	251.7		128.0	58.8
June	Tolsma Artis	196.4		1654.3		165.0
June	Gilderbloom	149.0		1254.6		188.0
June	Countess Flavia	152.4		1246.9		141.0
June	Barbara Allen	167.9		1346.3		217.0
June	Manton Belle	196.3		1519.3		235.7
June	Junietta Peerless	167.9		1394.0		219.0
June	Nellie 6th	88.3		707.9		144.6
June	Maggie 6th	145.7		1155.0		174.5
June	Ione	154.5		827.2	41.0	117.6
July	Tolsma Artis	184.4		1872.0		60.3
July	Gilderbloom	153.5		1531.7		217.0

July	Countess Flavia	138.8	....	1565.8	....	50.0
July	Barbara Allen	155.0	....	1645.5	....	260.4
July	Manton Belle	182.4	....	1831.0	....	228.7
July	Junietta Peerless	154.6	....	1721.8	....	259.1
July	Nellie 6th	82.0	....	935.0	....	108.5
July	Maggie 6th	150.0	....	1594.8	....	241.5
July	Ione	150.6	....	1329.1	....	185.6
August	Gilderbloom	349.8	....	521.1	....	217.0
August	Countess Flavia	318.7	....	534.6	....	90.0
August	Barbara Allen	416.4	....	560.2	....	234.0
August	Manton Belle	443.9	....	550.7	....	229.8
August	Junietta Peerless	425.4	....	576.1	....	274.0
August	Nellie 6th	194.5	....	365.1	....	102.0
August	Maggie 6th	385.3	....	531.9	....	274.0
August	Ione	356.2	....	501.8	....	212.0
September	Gilderbloom	142.9	....	1580.0	....	195.0
September	Countess Flavia	149.9	....	1558.2	....	45.0
September	Barbara Allen	178.4	....	1226.7	....	238.8
September	Manton Belle	178.7	....	1408.9	....	196.9
September	Junietta Peerless	179.4	....	1649.5	....	251.0
September	Maggie 6th	141.7	....	1575.6	....	255.0
September	Ione	144.0	....	1572.2	....	194.9
October	Gilderbloom	148.9	....	964.8	610.8	201.5
October	Countess Flavia	64.8	....	386.4	....	....
October	Barbara Allen	185.3	....	1069.2	630.0	216.5
October	Manton Belle	183.6	....	939.2	503.0	106.2
October	Junietta Peerless	185.8	....	1119.0	629.0	263.5
October	Maggie 6th	147.5	....	956.6	630.0	263.4
October	Ione	142.4	....	1055.8	628.6	206.0
November	Gilderbloom	140.8	1306.8	....	....	185.0
November	Barbara Allen	179.0	1450.5	....	....	230.8

TABLE 4. FOOD FED COWS DURING EXPERIMENTS — (*Continued*).

	COW.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1893.						
November...	Manton Belle	166.8	280.0	....	....	....
November...	Junietta Peerless	176.7	1472.6	....	....	256.0
November...	Maggie 6th	146.3	1112.3	....	....	244.5
November...	Ione	68.1	446.8	....	....	92.5

TABLE 5.

FOOD FED COWS DURING EXPERIMENTS.

Fourth period of lactation.

	COW.	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.
1893.						
April	Miss Flow 5th	91.8	83.6	....	91.0	45.5
May	Miss Flow 5th	153.3	978.9	....	....	153.5
June	Miss Flow 5th	167.8	....	1369.5	....	216.5
July	Miss Flow 5th	155.0	....	1720.8	....	247.7
August	Miss Flow 5th	425.7	....	484.1	....	274.0
September	Miss Flow 5th	175.2	....	1604.8	....	255.0
October	Miss Flow 5th	185.8	....	1113.7	629.8	263.5
November	Miss Flow 5th	177.4	1346.7	....	....	244.5
November	Countess Flavia	139.0	821.1	....	195.7	119.0

TABLE 6.

COMPOSITION BY WEIGHT OF GRAIN MIXTURES.

	Cottonseed meal.	Corn meal.	Wheat bran.	Ground oats.	Linseed meal, old process.	Linseed meal, new process.	Wheat middlings.	Gluten meal.	Ground flax-seed.	Gluten feed.	Cost per ton.
Number 30	3	.....	5	.....	1	.....	1	.....	.....	.....	$23 53
Number 31	1	2	6	1	1	.....	2	.....	.....	.....	21 35
Number 32	.....	4	5	1	.....	1	1	.....	.....	.....	20 42
Number 33	.....	3	3	3	1	.....	1	.....	1	.....	25 12
Number 34	1	5	5	2	1	.....	1	4	1	.....	24 52
Number 35	.....	1	6	.....	1	.....	1	.....	.....	3	20 04

PROXIMATE CONSTITUENTS OF THE DRY MATTER IN FOODS FED COWS DURING EXPERIMENT.

TABLE 7.

Analyses of cattle foods, 1893.

FOODS.	Time fed.	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Fat.	Invert sugar.	Sucrose.	Starch.	Albuminoid nitrogen.	Amide nitrogen.
Mixed hay	December 1, 1892, to January 31, 1893	11.54	5.16	6.00	32.74	51.39	4.71	3.55	4.16	18.30	0.96	0.01
Corn ensilage	December 14, 1892, to January 31, 1893	74.29	4.38	10.13	19.62	60.35	5.52	0.35	0.86	17.20	7.07	0.55
Mixed grain, No. 29	December 1, 1892, to January 31, 1893	11.68	5.22	27.69	7.03	54.85	5.21	0.49	1.53	35.80	4.38	0.05
Ground oats	December 1, 1892, to July 1, 1893	15.33	3.76	12.25	10.26	67.72	6.01	1.54	0.41	66.10	1.95	0.00
Wheat bran	December 1, 1892, to July 1, 1893	13.04	6.86	16.94	8.92	62.29	4.99	0.61	4.29	59.20	2.61	0.10
Mixed hay	February 1 to March 31, 1893	13.09	6.51	8.25	31.59	50.06	3.59	2.23	1.59	22.10	1.32	0.00
Mixed grain, No. 30	February 1 to March 31, 1893	13.29	6.02	26.50	6.82	54.72	5.94	0.00	3.01	42.40	4.09	0.15
Corn ensilage	February 1 to May 31, 1893	75.39	4.78	9.94	19.85	59.02	6.41	0.00	0.55	44.10	1.06	0.53
Mixed hay	April 1 to July 1, 1893	14.47	5.73	10.56	31.74	46.30	5.67	3.95	1.96	17.20	1.58	0.11
Mixed grain, No. 31	April 1 to June 1, 1893	13.83	4.85	18.31	6.52	65.36	4.96	0.88	2.58	60.80	2.82	0.11
Mixed hay	April 14 to July 1, 1893	13.33	5.86	8.06	30.71	50.74	4.63	6.25	2.17	19.90	1.25	0.04
Mixed grain, No. 32	June 1 to September 1, 1893	13.65	4.09	14.44	6.03	71.68	3.76	0.84	2.09	70.80	2.45	0.02
Alfalfa forage	June 1 to July 1, 1893	77.86	9.06	17.00	29.33	38.29	6.32	1.92	1.28	13.50	2.17	0.55
Rye forage	June 1 to June 10, 1893	76.86	5.96	10.81	33.60	44.06	5.57	4.32	1.94	16.40	1.49	0.24
Oat and pea forage	July 1 to July 15, 1893	84.20	9.30	19.62	26.65	37.48	6.95	2.09	0.98	14.40	2.23	0.91
Mixed hay	July 1 to August 8, 1893	12.63	5.81	10.00	32.69	46.24	5.26	2.97	1.21	16.10	1.50	0.10
Alfalfa forage	July 16 to August 2, 1893	74.95	8.58	17.06	31.35	37.54	5.47	0.81	0.96	15.40	2.06	0.67
Mixed grain, No. 33	August 1 to August 15, 1893	11.76	3.76	14.69	7.08	66.98	7.49	0.84	0.70	50.20	2.33	0.02
Wheat bran	July 1 to December 31, 1893	13.89	6.75	15.06	9.24	64.44	4.51	0.58	2.98	45.40	2.29	0.12
Mixed hay	August 9 to September 1, 1893	12.35	6.46	9.56	34.26	44.56	5.16	1.61	1.91	16.80	1.44	0.09
Oat and pea forage	August 16 to September 1, 1893	81.79	12.55	21.69	23.96	34.12	7.68	1.48	0.57	13.80	2.44	1.03
Mixed grain, No. 34	August 16 to October 1, 1893	10.49	3.66	18.44	7.02	61.90	8.98	0.41	1.08	46.80	2.92	0.03
Mixed hay	September 1 to September 21, 1893	14.47	4.99	6.12	32.91	50.73	5.25	4.23	3.71	18.00	0.93	0.05
Alfalfa forage	September 1 to October 1, 1893	73.32	7.62	17.56	28.20	40.77	5.85	1.28	0.46	9.80	2.15	0.66
Corn forage	September 1 to October 1, 1893	73.43	4.06	8.37	18.24	64.11	5.22	9.35	1.85	34.10	1.15	0.19
Mixed hay	September 22 to November 1, 1893	10.86	4.58	5.37	31.98	53.22	4.85	3.08	2.93	19.10	0.85	0.01
Mixed grain, No. 35	October 1 to December 1, 1893	14.12	4.33	18.94	7.21	61.66	7.86	0.74	1.85	40.60	2.88	0.15
Sorghum forage	October 1 to October 20, 1893	75.32	3.90	6.25	20.51	64.86	4.48	9.06	11.60	20.30	0.86	0.14
Alfalfa forage	October 1 to October 20, 1893	77.69	10.19	23.12	21.68	37.75	7.26	0.94	1.47	9.90	2.60	1.10
Beets	October 1 to December 31, 1893	83.77	12.63	11.56	5.71	67.60	2.50	3.32	37.12	1.85	0.96	0.89
Mixed hay	November 1 to December 31, 1893	15.07	5.42	10.00	32.71	47.32	4.55	3.19	2.32	14.40	1.51	0.69
Corn ensilage	November 1 to December 31, 1893	77.20	6.21	7.63	24.83	58.81	2.52	3.00	0.17	22.50	0.56	0.66

Proximate Composition of Food Fed and also the Weight of Each Animal for Each Month of the Investigation.

The following tables give the number of pounds of each food constituent consumed every month, as also the weight of each animal.

Each table will show very considerable changes in the proximate composition of the several rations, and the result of such changes may be studied with profit in connection with the tables following later, in which tables are given the milk yield and its composition for each month of the experiment.

The tables 8 to 15 inclusive, are continuations from the eleventh annual report of the *first* period of lactation.

The first four, 8 to 11 inclusive, giving the food constituents of these four animals followed by four other tables, 12 to 15 inclusive, giving the amount and composition of the milk yield.

Tables 16 to 27 inclusive, are continuations from the eleventh annual report of the *second* period of lactation, presenting the same data as to food and milk yield.

Tables 28 to 33 inclusive, give similar data for three animals in their *first* period of lactation.

Tables 34 to 45 inclusive, give similar results for six animals in their *second* period of lactation.

Tables 46 to 65 inclusive, give the same data for ten animals in their *third* period of lactation.

Tables 66 to 72 inclusive, give the food constituents in pounds consumed by each animal during each month of the third period of lactation, also pounds of milk yielded by each animal.

Tables 73 to 77 inclusive, give the per cent of each milk constituent for each cow during each month of the third period of lactation.

Tables 78 to 82 inclusive, give the pounds of each milk constituent yielded by each cow in each month of the third period of lactation.

Tables 83 to 89 inclusive, give the average food constituents in pounds consumed by each breed during each month of the third period of lactation, also the pounds of milk yielded on an average by each breed.

Tables 90 to 94 inclusive, give the average per cent of each milk constituent of each breed during each month of the third period of lactation.

Tables 95 to 99 inclusive, give average pounds of each milk constituent yielded by each breed in each month of the third period of lactation.

Table 100 gives the general average of all breeds for each month of the third period of lactation.

Table 101 gives the general average of all breeds for each month of first, second and third periods of lactation.

Table 102 gives the relation of fat in food to fat in milk for the first period of lactation.

Table 103 gives the relation of fat in food to fat in milk for the second period of lactation.

Table 104 gives the relation of fat in food to fat in milk for the third period of lactation.

Table 105 gives the cost of production of milk and fat for each animal for the first period of lactation.

Table 106 gives the cost of production of milk and fat for each animal for the second period of lactation.

Table 107 gives the cost of production of milk and fat for each animal for the third period of lactation.

Table 108 gives the relative cost of production of milk and fat for each animal and each breed during the first period of lactation.

Table 109 gives the relative cost of production of milk and fat for each animal and each breed during the second period of lactation.

Table 110 gives the relative cost of production of milk and fat for each animal and each breed during the third period of lactation.

Table 111 gives the cost of milk and fat, also relative cost of each cow for their entire period under experiment.

Table 112 gives certain general results in food and production of each cow during the first period of lactation.

Tables 113 and 114 give the same general results in food and production of each cow during second and third periods of lactation.

Table 115 gives average food fed each animal from January, 1890, to December, 1893.

Table 116 gives percentage variation by months in food and milk constituents.

Table 117 gives number of days and daily milk yield for each cow in successive periods of lactation.

Table 118 gives daily milk yield of each cow morning and evening for successive periods of lactation.

Table 119 gives relative number and size of milk globules for each breed in successive periods of lactation.

Table 120 gives the average per cent of total fat in the different sized globules during successive periods of lactation.

Tables 121, 122 and 123 give comparison of food and milk constituents of all cows during good flow of milk from February, 1890, to December, 1893.

TABLE 8.

BEAUTY PLEDGE — HOLSTEIN-FRIESIAN.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1892.							
December	960	87.31	397.8	214.9	31.6	109.1	38.1
1893.							
January	976	75.37	361.9	174.1	33.4	146.9	32.5
February	1018	72.69	327.1	218.6	30.2	136.1	36.0
March	1052	80.56	362.7	242.2	33.4	150.9	39.9

TABLE 9.

ALBERT'S CAROL — JERSEY.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1892.							
December	690	83.06	338.7	185.7	27.6	91.5	32.2
1893.							
January	733	77.94	328.2	164.9	30.4	124.6	29.7
February	755	70.31	281.5	194.1	26.6	106.6	30.8
March	760	77.75	311.4	214.9	29.5	117.8	34.1

TABLE 10.

STELLA SELECT — GUERNSEY.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1892.							
December	865	86.75	386.9	207.5	30.9	106.6	36.9
1893.							
January	926	76.25	342.5	168.6	31.6	135.0	30.9
February	952	67.37	290.9	196.9	27.1	116.8	31.9
March	977	56.50	283.4	185.8	25.8	124.5	31.0

TABLE 11.

BETSY 10TH — SHORT-HORN.

Conclusion of first period.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat	Fiber.	Ash.
1892.							
December	901	101.87	420.0	229.5	34.0	112.7	40.0
1893.							
January	992	98.56	412.5	207.7	38.2	156.0	37.3
February	1044	84.56	349.8	238.6	32.8	137.0	38.4
March	1081	93.37	386.4	263.5	36.2	151.2	42.4

TABLE 12.

BEAUTY PLEDGE — HOLSTEIN-FRIESIAN.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
December ..	561.4	12.52	2.99	3.14	5.72	0.67	70.3	16.8	17.6	32.1	3.8
1893.											
January....	551.1	12.28	3.81	3.16	4.60	0.71	67.7	21.0	17.4	25.4	3.9
February...	482.3	12.20	3.50	3.07	5.09	0.54	58.8	16.9	14.8	24.5	2.6
March	537.0	12.25	3.65	3.13	4.85	0.62	65.8	19.6	16.8	26.1	3.3

TABLE 13.

ALBERT'S CAROL — JERSEY.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
December...	434.6	17.06	6.35	4.29	5.58	0.84	74.1	27.6	18.6	24.2	3.7
1893.											
January....	429.9	16.90	6.97	4.34	4.88	0.71	72.7	30.0	18.7	21.0	3.0
February...	374.4	17.10	7.05	4.18	5.19	0.6	64.0	26.4	15.7	19.4	2.5
March	408.0	16.81	7.00	4.37	4.65	0.79	68.6	28.6	17.8	19.0	3.2

TABLE 14.

STELLA SELECT — GUERNSEY.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
December . .	394.7	17.02	6.31	4.37	5.54	0.80	67.2	24.9	17.2	21.9	3.2
1893.											
January	381.4	16.31	6.45	3.89	5.25	0.72	62.2	24.6	14.8	20.0	2.8
February . . .	330.0	16.73	7.00	4.01	5.03	0.69	55.2	23.1	13.2	16.6	2.3
March	316.0	16.54	6.45	3.89	5.48	0.72	52.3	20.4	12.3	17.3	2.3

TABLE 15.

BETSY 10TH — SHORTHORN.

Conclusion of first period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
December ..	445.2	15.20	4.43	4.33	5.66	0.78	67.7	19.7	19.3	25.3	3.5
1893.											
January....	411.8	15.37	5.01	4.34	5.21	0.81	63.3	20.6	17.9	21.5	3.3
February...	369.4	15.12	4.80	4.38	5.16	0.78	55.9	17.7	16.2	19.1	2.9
March	394.0	14.98	4.80	4.28	5.11	0.79	59.0	18.9	16.9	20.1	3.1

TABLE 16.

GILDERBLOOM — JERSEY.

Conclusion of second period.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1892.							
December	878	68.87	330.9	175.2	26.0	93.1	31.6
1893.							
January	950	58.87	289.9	138.8	26.7	119.7	26.0
February	992	54.62	249.3	166.9	23.1	103.5	27.3
March	1006	37.00	225.8	143.1	20.1	108.4	24.7

TABLE 17.

BARBARA ALLEN — JERSEY.

Conclusion of second period.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1892.							
December	893	85.19	373.3	203.0	29.7	101.6	35.8
1893.							
January	961	79.37	340.4	171.2	31.5	132.5	30.9
February	991	71.06	292.6	198.8	27.3	115.3	27.3
March	1038	55.37	274.2	178.9	24.8	121.5	30.3

TABLE 18.

JUNIETTA PEERLESS — AYSHIRE.

Conclusion of second period.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1892.							
December	937	88.31	406.7	219.0	32.4	114.0	38.9
1893.							
January	979	73.12	351.3	171.4	32.4	146.6	31.8
February	1064	62.31	295.9	193.4	26.7	129.8	32.9
March	1067	46.00	278.4	173.3	24.3	137.6	31.0

TABLE 19.

MAGGIE 6TH — AMERICAN-HOLDERNESS.

Conclusion of second period.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1892.							
December	896	92.56	390.0	212.4	31.2	102.0	37.2
1893.							
January	978	86.00	348.6	173.0	32.3	127.0	31.4
February	1004	68.19	271.2	188.0	25.8	101.3	29.6
March	1019	44.37	238.2	157.1	21.9	104.6	25.6

TABLE 20.

IONE — DEVON.

Conclusion of second period.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1892.							
December	943	90.50	369.7	205.0	29.7	99.0	35.6
1893.							
January	1019	79.81	328.7	168.0	30.4	125.7	30.0
February	1055	55.81	251.0	166.2	22.9	106.3	27.9
March	1091	43.75	240.4	152.4	21.3	113.9	26.8

TABLE 21.

ESEL 2ND — HOLSTEIN-FRIESIAN.

Conclusion of second period.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1892.							
December	1228	119.25	512.0	276.8	41.5	142.9	48.8
1893.							
January	1309	112.25	484.2	241.6	44.8	186.7	43.7
February	1365	69.56	408.0	277.7	38.2	160.9	44.7
March	1435	105.31	438.8	300.7	41.3	170.1	47.8
April	1454	82.62	443.7	347.1	44.5	144.6	38.8
May	1452	82.87	436.1	341.8	43.5	141.7	38.2
June	1482	84.44	326.7	226.4	35.3	154.1	43.7
July	1488	85.00	312.9	202.0	35.5	166.8	46.9
August	1461	73.37	303.1	169.5	39.1	170.6	41.6
September	1461	61.94	320.4	188.7	35.6	132.7	30.5

TABLE 22.

Gilderbloom — Jersey.

Conclusion of second period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
December ..	250.0	17.28	6.45	4.47	5.62	0.74	43.2	16.1	11.2	14.1	1.8
1893.											
January....	215.1	16.93	6.85	4.38	4.91	0.79	36.4	14.7	9.4	10.6	1.7
February...	175.4	16.98	6.60	4.44	5.21	0.73	29.8	11.6	7.8	9.1	1.3
March	108.2	16.89	6.95	4.36	4.85	0.73	18.3	7.5	4.7	5.3	0.8

TABLE 23.

BARBARA ALLEN — JERSEY.

Conclusion of second period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
December . .	374.9	16.91	6.03	4.72	5.37	0.79	63.4	22.6	17.7	20.1	3.0
1893.											
January	356.7	17.14	6.66	4.48	5.34	0.66	61.1	23.8	16.0	19.0	2.3
February . . .	270.6	17.28	6.75	4.32	5.44	0.77	46.8	18.3	11.7	14.7	2.1
March	166.4	17.48	6.40	4.87	5.49	0.72	29.1	10.7	8.1	9.1	1.2

TABLE 24.

JUNIETTA PEERLESS — AYRSHIRE.

Conclusion of second period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
December . .	675.9	13.03	3.35	3.45	5.58	0.65	88.1	22.7	23.3	37.7	4.4
1893.											
January	465.2	13.31	4.13	3.52	5.05	0.61	61.9	19.2	16.4	23.5	2.8
February . . .	169.7	13.20	4.33	4.31	3.87	0.69	22.4	7.3	7.3	6.6	1.2
March	49.2	13.95	4.20	4.10	4.99	0.66	6.9	2.1	2.0	2.5	0.3

TABLE 25.

MAGGIE 6TH — AMERICAN HOLDERNESS.

Conclusion of second period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds Ash.
1892.											
December ..	537.5	13.20	4.00	3.40	5.19	0.61	70.9	21.5	18.2	27.9	3.3
1893.											
January ...	446.4	13.66	4.39	3.49	5.15	0.63	61.0	19.6	15.6	23.0	2.8
February...	281.6	14.56	5.05	3.77	5.06	0.68	41.0	14.2	10.6	14.3	1.9
March	76.4	16.90	6.07	5.28	4.70	0.85	12.9	4.6	4.0	3.7	0.6

TABLE 26.

IONE — DEVON.

Conclusion of second period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
December . .	410.1	14.90	4.89	4.09	5.19	0.73	61.1	20.0	16.8	21.3	3.0
1893.											
January	313.4	15.38	5.38	4.32	4.95	0.73	48.2	16.9	13.5	15.5	2.3
February . . .	135.7	15.99	5.95	4.42	4.84	0.78	21.7	8.1	6.0	6.6	1.0
March	45.2	14.99	5.23	4.47	4.50	0.79	6.8	2.4	2.0	2.0	0.4

TABLE 27.

ESEL 2ND — HOLSTEIN-FRIESIAN.

Conclusion of second period.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
December ..	758.2	12.94	3.64	3.47	5.16	0.67	98.1	27.6	26.3	39.1	5.1
1893.											
January	656.1	12.52	3.66	3.51	4.66	0.69	82.1	24.0	23.0	30.6	4.5
February ...	543.2	12.35	3.73	3.52	4.46	0.64	67.1	20.3	19.1	24.2	3.5
March	563.3	12.43	3.65	3.44	4.67	0.67	70.0	20.5	19.4	26.3	3.8
April	449.6	12.24	3.25	3.44	4.87	0.68	55.9	16.4	15.5	21.0	3.0
May	428.5	12.55	3.55	3.39	4.93	0.68	53.8	15.2	14.6	21.1	2.9
June	379.4	12.91	3.85	3.52	4.88	0.66	49.0	14.6	13.4	18.5	2.5
July	400.1	13.15	4.20	3.48	4.80	0.67	52.6	16.8	13.9	19.2	2.7
August	358.5	13.10	4.30	3.54	4.57	0.69	47.0	15.4	12.7	16.4	2.5
September ..	300.6	13.53	4.40	3.50	4.93	0.70	40.6	13.2	10.5	14.8	2.1

TABLE 28.

NETHERLAND CONSTANCE — HOLSTEIN-FRIESIAN.

First Period — Calved October 13, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1892.							
October	1175	31.31	206.6	138.3	18.0	66.8	16.0
November	989	72.00	392.4	224.4	35.3	126.9	39.9
December	965	103.62	437.9	242.0	35.4	121.3	42.2
1893.							
January	1022	103.81	403.0	208.0	37.4	144.6	36.5
February	1052	95.75	365.6	252.4	34.5	136.7	40.5
March	1073	106.50	406.4	280.1	38.2	152.5	45.1
April	1099	79.94	402.8	312.1	39.4	123.9	34.9
May	1087	71.31	359.6	283.5	35.5	115.6	31.7
June	1069	87.69	344.2	244.3	36.1	155.9	44.4
July	1068	91.75	346.8	241.2	36.7	163.9	47.9
August	1005	83.81	339.4	197.7	44.4	175.5	44.7
September	1048	81.69	411.6	248.0	46.2	160.9	38.1
October	1057	65.50	365.6	210.1	35.6	119.0	41.7
November	1001	49.19	324.4	162.8	24.8	130.4	31.9

TABLE 29.

DAY DREAM B — DEVON.

First Period — Calved April 29, 1893.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
May	988	27.87	158.2	117.8	16.1	58.3	16.3
June	877	53.44	198.1	123.5	23.8	109.9	30.0
July	896	62.25	227.0	147.0	25.9	120.8	34.4
August	916	48.25	202.3	108.5	26.0	125.1	30.9
September	951	63.69	327.4	190.8	36.3	132.9	31.1
October	937	50.19	280.1	163.9	27.0	90.8	33.4
November	931	37.25	260.8	92.3	18.6	101.5	25.7

TABLE 30.

LADY SPENCER — SHORTHORN.

First Period — Calved October 18, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1892.							
November	1120	67.81	387.0	222.1	34.5	131.3	39.6
December	1125	107.31	469.6	254.1	38.2	135.3	44.8
1893.							
January	1221	110.31	463.7	236.1	42.9	180.9	42.4
February	1281	95.25	390.2	263.6	36.1	155.6	43.4
March	1285	105.50	432.8	292.3	40.1	172.9	48.1
April	1333	80.62	420.8	328.5	42.1	138.6	37.1
May	1330	78.69	417.5	322.8	42.1	141.0	37.0
June	1389	78.19	298.9	196.2	34.0	154.1	42.1
July	1381	80.75	296.3	189.7	33.9	159.7	44.8
August	1375	68.94	279.5	153.9	36.6	155.6	39.5
September	1388	69.87	372.3	217.2	40.5	156.8	35.8
October	1421	57.62	351.3	198.6	32.5	119.4	41.4
November	1436	41.69	311.1	149.3	21.8	133.8	31.6

TABLE 31.

NETHERLAND CONSTANCE — HOLSTEIN-FRIESIAN.

First Period — Calved October 13, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
October ...	574.0	11.28	2.70	2.91	4.87	0.80	64.7	15.5	16.7	27.9	4.6
November ..	1090.3	10.98	2.77	2.70	4.86	0.65	119.7	30.2	29.4	53.0	7.1
December ..	1168.1	10.92	2.57	2.72	4.92	0.71	127.5	30.0	31.8	57.5	8.2
1893.											
January	1060.5	11.26	2.98	2.82	4.81	0.65	119.4	31.6	29.9	51.0	6.9
February ...	950.5	11.21	3.23	2.85	4.55	0.58	106.6	30.7	27.1	43.3	5.5
March.....	999.3	11.52	3.18	2.98	4.66	0.70	115.1	31.8	29.8	46.5	7.0
April	947.8	11.38	2.88	2.92	4.92	0.66	107.9	27.3	27.7	46.6	6.3
May	892.5	11.52	3.02	3.05	4.79	0.66	102.8	26.9	27.2	42.8	5.9
June	789.1	10.80	3.00	2.86	4.36	0.58	85.2	23.7	22.5	34.4	4.6
July	827.5	11.50	2.90	3.12	4.84	0.64	95.2	24.0	25.8	40.1	5.3
August.....	660.3	12.06	3.40	3.23	4.80	0.63	79.6	22.4	21.3	31.7	4.2
September ..	760.4	12.19	3.20	3.23	5.07	0.69	92.7	24.3	24.6	38.5	5.3
October	731.1	11.22	2.75	3.17	4.70	0.60	82.0	20.1	23.2	34.3	4.4
November ..	652.9	11.63	3.10	3.07	4.82	0.64	75.9	20.2	20.0	31.5	4.2

TABLE 32.

DAY DREAM B — DEVON.

First Period — Calved April 29, 1893.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
May	254.6	13.69	4.50	3.36	5.18	0.65	34.9	11.5	8.5	13.2	1.7
June	307.6	13.47	4.35	3.37	5.09	0.66	41.4	13.4	10.4	15.6	2.0
July	323.4	13.65	4.35	3.53	5.10	0.67	44.1	14.0	11.4	16.5	2.2
August	335.4	14.12	4.60	3.69	5.16	0.67	47.4	15.4	12.4	17.3	2.3
September ..	383.2	15.09	5.60	3.74	5.00	0.75	57.8	21.4	14.3	19.2	2.9
October	324.0	16.17	6.30	3.91	5.18	0.78	52.4	20.4	12.7	16.8	2.5
November ..	264.1	15.78	5.85	3.92	5.32	0.69	41.7	15.4	10.4	14.1	1.8

TABLE 33.

LADY SPENCER — SHORTHORN.

First Period — Calved October 18, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
November..	548.0	13.20	3.62	3.31	5.53	0.74	72.3	19.8	18.1	30.3	4.1
December..	510.8	13.50	3.90	3.37	5.55	0.68	68.9	19.9	17.2	28.3	3.5
1893.											
January....	452.8	13.58	4.02	3.62	5.24	0.70	61.5	18.2	16.4	23.7	3.2
February...	363.9	13.36	4.25	3.58	4.86	0.67	48.6	15.5	13.0	17.7	2.4
March	388.9	13.44	4.20	3.60	4.95	0.69	52.3	16.3	14.0	19.3	2.7
April	345.0	13.54	3.90	3.57	5.37	0.70	46.7	13.5	12.3	18.5	2.4
May	302.7	13.41	4.15	3.60	4.98	0.68	40.6	12.6	10.9	15.1	2.0
June	257.7	13.40	4.27	3.65	4.91	0.57	34.5	11.0	9.4	12.6	1.5
July	261.9	13.57	4.15	3.65	5.17	0.60	35.5	10.9	9.5	13.5	1.6
August	235.4	13.45	4.35	3.46	5.03	0.61	31.6	10.2	8.1	11.9	1.4
September..	227.5	13.06	4.10	3.45	4.91	0.60	29.7	9.3	7.8	11.2	1.4
October ...	197.2	13.24	4.00	3.57	5.05	0.62	26.1	7.9	7.0	10.0	1.2
November..	175.9	13.59	4.80	3.53	4.60	0.66	23.9	8.4	6.2	8.1	1.2

TABLE 34.

ROSETTE FORD — GUERNSEY.

Second Period — Calved January 30, 1893.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
February	1094	60.00	273.5	193.8	24.6	107.1	30.1
March	945	93.25	361.1	250.7	34.3	133.6	39.6
April	944	79.94	414.2	331.2	40.7	126.8	35.7
May	953	80.25	414.1	332.5	40.5	125.2	35.6
June	963	92.31	363.1	270.6	37.0	155.7	45.7
July	955	96.94	366.9	263.5	37.8	165.2	49.5
August	988	90.50	366.1	218.1	47.6	171.3	44.9
September	1025	91.06	439.7	270.1	50.8	163.4	39.8
October	1049	79.69	429.2	252.8	42.3	129.4	47.0
November	1040	61.62	388.8	200.7	30.7	146.2	37.4

TABLE 35.

ORIOLE — GUERNSEY.

Second Period — Calved December 8, 1892.

MONTH.	Weight.	Albuminoids	Nitrogen-free extracts.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1892.							
December	897	22.87	213.1	99.6	18.0	75.6	18.1
1893.							
January	775	94.19	402.9	201.3	37.3	154.4	36.4
February	836	91.62	367.2	252.0	34.5	140.8	40.4
March	857	95.94	393.9	268.9	36.9	153.6	43.3
April	873	67.25	366.5	284.8	37.0	121.4	32.1
May	866	67.31	368.0	288.2	37.0	119.2	32.0
June	890	78.31	300.5	205.2	33.1	145.8	41.1
July	883	82.44	305.8	208.7	33.3	150.8	44.0
August	885	74.62	300.7	172.8	39.4	153.0	38.6
September	878	72.69	369.2	218.8	41.2	149.1	35.1
October	892	55.25	294.6	166.8	30.8	105.9	31.2
November	859	46.69	318.4	161.2	23.8	124.3	31.2

TABLE 36.

MADAME SELECT — GUERNSEY.

Second Period — Calved October 13, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1892.							
October	824	36.87	230.5	144.7	22.2	76.9	17.1
November	753	71.00	375.4	214.8	34.1	116.5	37.7
December	770	93.56	398.7	216.2	32.0	106.9	38.0
1893.							
January	803	87.88	364.5	184.0	33.7	136.9	33.0
February	827	73.81	303.4	207.9	28.5	117.3	33.2
March	831	81.12	334.8	229.2	31.5	129.9	36.7
April	852	63.31	350.7	272.8	35.5	115.5	30.6
May	865	60.81	336.5	261.4	34.1	111.4	29.4
June	883	69.87	266.6	175.6	30.3	136.8	37.7
July	872	74.44	276.3	182.7	30.6	142.1	40.4
August	886	61.19	253.4	140.5	32.7	138.8	34.4
September	907	51.69	287.5	165.8	30.5	124.8	27.9

TABLE 37.

STELLA SELECT — GUERNSEY.

Second Period — Calved May 29, 1893.

MONTH	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugar .	Crude fat.	Fiber.	Ash.
June	868	73.12	273.3	180.0	31.7	141.3	39.9
July	816	92.69	349.1	246.5	36.5	162.1	48.0
August........................	870	89.94	362.5	214.9	47.2	171.6	45.0
September	887	94.56	456.1	281.2	52.7	166.7	40.8
October	898	82.06	437.7	258.7	43.3	130.6	47.6
November	890	57.37	367.4	188.1	28.7	140.5	35.6

TABLE 38.

GENEVIE'S GIFT — DEVON.

Second Period — Calved October 30, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1892.							
November	785	51.50	287.5	167.5	25.2	89.8	29.9
December	734	73.31	319.7	174.9	25.0	82.8	30.8
1893.							
January	771	67.37	286.1	143.0	26.5	108.6	25.8
February	776	61.00	246.2	169.3	23.2	94.1	27.0
March	807	66.75	265.8	182.3	25.0	101.8	29.3
April	789	53.37	282.0	221.4	28.1	91.2	24.7
May	812	54.50	284.3	223.2	28.3	92.1	24.9
June	849	62.31	240.1	167.5	25.9	112.7	32.2
July	863	62.75	228.8	147.8	26.1	122.1	34.7
August	883	53.69	220.4	121.1	28.7	129.8	32.4

TABLE 39.

Artalia — Devon.

Second Period — Calved June 26, 1893.

MONTH.	Weight	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
July	994	74.25	278.8	187.9	30.3	139.1	39.7
August	993	75.31	302.3	179.9	39.6	148.7	39.0
September	1001	81.81	397.8	242.1	45.5	150.7	36.8
October	1027	70.81	383.8	225.4	37.4	114.8	43.5
November	1027	53.12	337.7	174.3	26.5	126.1	32.5

TABLE. 40.

ROSETTE FORD — GUERNSEY.

Second Period — Calved January 30, 1893.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
February ...	698.6	14.22	5.32	3.17	5.07	0.66	99.3	37.2	22.1	35.4	4.6
March	1019.2	14.41	5.55	2.85	5.38	0.63	146.9	56.6	29.1	54.8	6.4
April	918.5	14.51	5.28	3.06	5.54	0.63	133.3	48.5	28.1	50.9	5.8
May	822.0	15.33	5.58	3.55	5.53	0.67	125.7	45.8	29.1	45.3	5.5
June	674.2	16.11	5.98	3.91	5.55	0.67	108.6	40.3	26.4	37.4	4.5
July	532.9	16.39	5.70	4.45	5.51	0.73	87.3	30.4	23.7	29.3	3.9
August.....	424.9	16.83	6.18	4.44	5.45	0.76	71.5	26.3	18.9	23.1	3.2
September ..	430.5	17.32	6.65	4.77	5.15	0.75	74.5	28.6	20.5	22.2	3.2
October	304.7	17.45	6.27	5.12	5.24	0.82	53.2	19.1	15.6	16.0	2.5
November ..	289.5	16.91	6.25	4.59	5.34	0.73	49.0	18.1	13.3	15.5	2.1

TABLE 41.

ORIOLE -- GUERNSEY.

Second Period — Calved December 8, 1892.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
December..	405.4	14.66	5.68	3.56	4.68	0.74	59.4	23.0	14.4	19.0	3.0
1893.											
January ...	733.8	14.41	5.08	3.49	5.12	0.72	105.7	37.3	25.6	37.5	5.3
February ..	630.2	14.84	5.37	3.76	4.99	0.72	93.5	33.8	23.7	31.5	4.5
March	661.2	15.07	5.60	3.73	5.05	0.69	99.6	37.0	24.7	33.4	4.5
April	629.5	14.82	5.38	3.62	5.11	0.71	93.3	33.9	22.8	32.1	4.5
May.......	646.5	15.18	5.87	3.78	4.83	0.70	98.1	38.0	24.4	31.2	4.5
June	561.2	14.64	5.35	3.62	4.99	0.68	82.1	30.0	20.3	28.0	3.8
July.......	558.9	14.47	5.17	3.61	5.06	0.63	80.9	28.9	20.2	28.3	3.5
August	540.6	14.40	5.25	3.39	5.14	0.62	77.8	28.4	18.3	27.8	3.3
September..	530.2	14.98	5.45	3.66	5.19	0.68	79.4	28.9	19.4	27.5	3.6
October	393.6	15.87	6.05	3.96	5.19	0.67	62.4	23.8	15.6	20.4	2.6
November..	368.8	15.50	5.65	4.04	5.08	0.73	57.1	20.8	14.9	18.7	2.7

TABLE 42.

MADAM SELECT — GUERNSEY.

Second Period — Calved October 13, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
October	346.2	15.69	5.50	4.04	5.31	0.84	54.3	19.0	14.0	18.4	2.9
November ..	581.7	16.23	5.80	4.27	5.42	0.74	94.4	33.7	24.8	31.6	4.6
December ..	551.6	17.24	6.31	4.71	5.41	0.81	95.1	34.8	26.0	29.8	4.5
1893.											
January	499.3	16.71	6.48	4.66	4.81	0.76	83.4	32.3	23.3	24.0	3.8
February ...	420.9	17.36	6.90	4.94	4.75	0.77	73.1	29.0	20.8	20.0	3.3
March	477.4	16.66	6.52	4.53	4.80	0.81	79.5	31.1	21.6	22.9	3.9
April	442.8	15.95	5.92	4.30	4.97	0.76	70.6	26.2	19.0	22.0	3.4
May	463.1	16.11	6.14	4.29	4.93	0.75	74.6	28.4	19.9	22.8	3.5
June	385.6	15.07	6.03	3.51	4.94	0.59	58.1	23.3	13.5	19.0	2.3
July	386.5	16.09	5.92	4.19	5.31	0.67	62.2	22.9	16.2	20.5	2.6
August	283.4	16.16	6.60	4.14	4.73	0.69	45.8	18.7	11.7	13.4	2.0
September ..	195.8	16.90	6.80	4.44	5.02	0.64	33.1	13.3	8.7	9.8	1.3

TABLE 43.

STELLA SELECT — GUERNSEY.

Second Period — Calved May 29, 1893.

MONTH.	Milk yield, pound.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
June	810.6	12.41	3.88	2.76	5.12	0.65	100.6	31.4	22.4	41.5	5.3
July.......	824.1	13.06	4.03	3.12	5.29	0.62	107.6	33.2	25.7	43.6	5.1
August	732.2	13.39	4.60	2.95	5.22	0.62	98.0	33.7	21.6	38.2	4.5
September..	739.5	14.34	5.08	3.40	5.23	0.63	106.0	37.6	25.1	38.7	4.6
October....	639.7	15.17	5.55	3.80	5.16	0.66	97.0	35.5	24.3	33.0	4.2
November..	539.4	16.09	6.00	3.94	5.48	0.67	86.8	32.4	21.2	29.6	3.6

TABLE 44.

GENEVIE'S GIFT — DEVON.

Second Period — Calved October 30, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent fat.	Per cent. casein.	Per cent sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
November ..	591.4	13.69	4.40	3.41	5.22	0.66	81.0	26.0	20.2	30.9	3.9
December ..	549.8	15.13	5.02	3.70	5.64	0.77	83.2	27.6	20.4	31.0	4.2
1893.											
January	457.8	15.40	5.68	3.67	5.36	0.69	70.5	26.0	16.8	24.5	3.2
February ...	404.3	14.78	5.57	3.58	4.93	0.70	59.7	22.5	14.5	19.9	2.8
March......	459.2	14.49	5.10	3.46	5.25	0.68	81.0	28.5	19.3	29.4	3.8
April	442.0	14.55	5.38	3.45	5.03	0.69	64.3	23.8	15.3	22.2	3.0
May	437.2	14.85	5.49	3.57	5.11	0.68	64.9	24.0	15.6	22.3	3.0
June	356.4	14.95	5.35	3.70	5.24	0.66	53.3	19.0	13.2	18.7	2.4
July	256.6	15.34	5.40	3.94	5.29	0.71	39.4	13.9	10.1	13.6	1.8
August	52.5	16.88	6.80	4.84	4.51	0.73	8.9	3.6	2.5	2.4	0.4

TABLE 45.

ARTALIA — DEVON.

Second Period — Calved June 26, 1893.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
July	566.8	14.45	4.55	3.80	5.41	0.69	81.9	25.8	21.5	30.7	3.9
August	520.9	13.23	4.07	3.49	5.04	0.63	68.9	21.2	18.1	26.3	3.3
September..	516.9	13.39	4.00	3.60	5.17	0.62	69.2	20.7	18.6	26.7	3.2
October	434.8	13.73	4.17	3.98	4.90	0.68	59.7	18.1	17.3	21.3	3.0
November..	397.1	14.11	4.45	3.95	5.00	0.71	56.1	17.7	15.7	19.9	2.8

TABLE 46.

Tolsma Artis — Holstein-Friesian.

Third Period — Calved August 4, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugar.	Fat.	Fiber.	Ash.
1892.							
August	1370	71.37	303.6	170.8	35.3	149.5	39.0
September	1094	110.31	408.8	250.2	47.5	171.1	53.8
October	1119	94.62	541.2	327.8	53.3	185.7	41.1
November	1189	78.37	450.4	260.2	40.8	147.0	45.7
December	1141	112.19	497.6	267.0	40.1	141.0	47.4
1893.							
January	1217	109.31	472.7	235.0	43.7	181.4	42.6
February	1259	75.75	357.8	238.3	33.0	136.7	39.0
March	1242	77.75	382.3	252.7	35.1	165.0	41.7
April	1266	66.62	393.8	293.1	41.4	145.1	35.3
May	1275	71.62	417.3	292.6	43.6	151.4	37.3
June	1331	86.06	324.2	208.5	37.8	172.2	47.2
July	1354	74.19	255.8	137.2	33.6	169.2	45.5

TABLE 47.

MISS FLOW 5TH — AYRSHIRE.

Third Period — Calved May 6, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Fat.	Fiber.	Ash.
1892.							
May	1099	26.44	230.1	165.8	19.1	103.4	25.1
June	917	70.44	301.2	199.2	35.8	137.8	44.1
July	910	76.25	408.5	254.6	45.3	186.4	49.7
August	965	105.56	411.1	240.8	48.7	184.3	53.7
September	936	102.06	369.9	222.3	44.2	159.7	51.0
October	950	85.75	488.9	294.9	48.1	168.8	37.3
November	980	75.31	411.6	235.7	37.2	133.8	41.5
December	973	93.94	418.5	227.2	33.5	116.3	40.1
1893.							
January	1037	83.31	370.6	185.2	34.2	148.7	33.7
February	1081	59.87	276.0	179.3	24.7	121.9	31.1

TABLE 48.

MANTON BELLE — AYRSHIRE.

Third Period — Calved November 21, 1892.

MONTH.	Weight.	Albuminoids	Nitrogen free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1892.							
November	1201	18.69	108.1	60.4	7.9	34.1	14.8
December	1064	107.00	463.6	251.6	37.3	130.2	44.4
1893.							
January	1087	115.69	482.3	244.9	44.6	184.5	43.8
February	1110	84.31	366.6	244.1	33.6	152.6	40.8
March	1104	98.75	418.8	280.5	38.5	171.5	46.6
April	1115	83.12	441.3	344.1	44.3	145.4	38.8
May	1112	83.94	441.7	344.4	44.2	145.7	38.9
June	1152	91.62	355.9	248.1	38.2	166.8	47.2
July	1142	95.19	356.2	242.7	38.5	175.0	50.6
August	1173	84.81	344.2	198.4	44.8	174.0	44.5
September	1169	78.94	388.2	236.0	44.5	148.8	35.5
October	1196	52.62	315.4	177.5	29.8	110.1	36.5
November	1180	32.31	218.2	92.0	16.6	129.1	24.3

TABLE 49.

JUNIETTE PEERLESS — AYRSHIRE.

Third Period — Calved May 5, 1893.

MONTH.	Weight.	Albuminoids	Nitrogen free extract.	Starch and sugars	Crude fat.	Fiber.	Ash.
1893.							
May	1065	41.87	230.1	169.8	23.9	87.7	22.5
June	882	83.37	323.5	227.0	34.6	149.9	42.8
July	890	93.94	355.3	253.2	36.7	157.1	47.7
August	898	90.44	363.6	215.4	47.5	172.3	45.5
September	931	100.12	453.9	280.6	52.3	166.5	40.7
October	946	82.06	437.8	258.8	43.4	130.6	47.6
November	928	65.56	404.4	210.4	32.5	148.3	38.6

TABLE 50.

GILDERBLOOM.— JERSEY.

Third Period — Calved April 13, 1893.

MONTH.	Weight.	Albuminoids	Nitrogen free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1893.							
April	1012	19.00	114.5	86.6	11.9	43.5	11.2
May	867	51.06	293.4	225.0	30.1	100.1	25.7
June	847	73.62	284.7	198.1	30.7	133.8	38.1
July	850	82.87	313.5	219.3	33.0	147.3	43.1
August	858	74.37	297.4	174.9	39.1	143.2	38.2
September	825	81.44	395.3	240.5	45.2	149.0	36.5
October	859	68.44	361.2	211.1	35.8	108.3	41.8
November	829	50.44	329.8	168.9	25.4	124.5	31.9

TABLE 51.

COUNTESS FLAVIA — JERSEY.

Third Period — Calved November 12, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugars	Crude fat.	Fiber.	Ash.
1892.							
November	878	33.06	182.0	99.5	13.9	56.5	24.4
December	778	89.44	372.4	217.0	29.6	99.2	36.0
1893.							
January	801	87.50	361.0	183.2	33.4	136.3	32.7
February	837	84.19	320.4	222.0	30.3	118.6	35.4
March	839	87.19	341.1	234.6	32.1	129.4	37.7
April	857	68.87	360.8	285.4	35.8	114.1	31.4
May	878	63.12	328.6	259.0	32.6	105.2	28.7
June	895	67.50	256.3	168.5	29.2	131.8	36.4
July	892	60.50	206.8	111.5	27.3	136.6	37.1
August	858	53.44	210.6	123.7	25.8	128.3	35.1
September	866	54.75	313.0	176.2	31.3	140.7	32.6

TABLE 52.

BARBARA ALLEN — JERSEY.

Third Period — Calved May 4, 1893.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1893.							
May	1038	43.06	235.1	172.4	24.4	90.8	23.3
June	875	81.75	318.0	223.8	33.8	146.5	41.8
July	881	91.94	350.0	250.7	35.9	157.1	46.8
August	883	83.94	335.7	195.3	44.0	166.1	43.3
September	901	91.25	443.2	271.9	51.0	164.1	40.0
October	914	73.81	405.9	237.3	39.5	125.1	45.1
November	874	61.75	388.7	200.7	30.8	146.1	37.4

TABLE 53.

MAGGIE SIXTH — AMERICAN-HOLDERNESS.

Third Period — Calved May 13, 1893.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1893.							
May	1052	26.25	133.5	95.6	13.7	55.3	15.0
June	853	69.25	265.3	184.0	28.8	124.8	35.7
July	835	87.87	332.9	236.8	34.5	152.2	45.1
August	834	86.06	344.8	206.9	45.1	158.2	42.3
September	852	91.19	427.3	265.8	49.9	152.2	38.4
October	867	78.00	394.2	234.3	39.9	111.5	44.4
November	879	58.50	337.4	180.5	28.5	118.7	31.6

TABLE 54.

NELLIE 6TH — AMERICAN-HOLDERNESS.

Third Period — Calved December 12, 1892.

MONTH.	Weight.	Albuminoids.	Nitrogen-free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1893.							
January	848	80.00	280.7	144.5	26.1	85.5	24.8
February	839	63.25	205.4	155.9	21.2	55.2	21.3
March	825	71.06	234.2	172.2	23.3	70.7	25.2
April	853	56.06	280.1	233.9	26.5	73.9	23.2
May	895	48.00	237.6	194.0	22.8	68.5	20.3
June	907	47.44	185.2	136.3	23.8	78.0	23.4
July	912	46.44	171.9	117.6	18.8	85.4	24.9
August	914	40.62	159.7	91.3	21.4	81.9	22.3

TABLE 55.

IONE — DEVON.

Third Period — Calved June 2, 1893.

MONTH.	Weight.	Albuminoids.	Nitrogen free extract.	Starch and sugars.	Crude fat.	Fiber.	Ash.
1893.							
June	1099	54.19	207.1	137.6	23.5	105.0	29.7
July	926	73.25	278.4	192.0	29.4	133.6	38.4
August	914	73.69	295.2	176.8	38.8	143.4	38.0
September	905	81.25	394.9	240.6	45.2	148.7	36.4
October	904	70.00	377.5	222.2	36.8	111.5	42.9
November*	908	23.31	136.3	71.9	11.4	49.9	12.9

* Ione died November 14, 1893.

TABLE 56.

TOLSMA ARTIS — HOLSTEIN-FRIESIAN.

Third Period — Calved August 4, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
August	705.5	11.15	3.21	2.52	4.87	0.55	78.7	22.6	17.8	34.4	3.9
September ..	1062.2	10.54	2.58	2.43	4.98	0.55	111.9	27.4	25.8	52.9	5.8
October ...	1092.8	10.65	2.65	2.55	4.76	0.69	116.4	29.0	27.9	52.0	7.5
November ..	927.9	11.20	2.66	2.86	4.94	0.74	103.9	24.7	26.5	45.8	6.9
December ..	919.1	11.95	3.09	3.14	5.05	0.67	109.8	28.4	28.9	46.4	6.1
1893.											
January	813.3	12.12	3.42	3.26	4.74	0.70	98.6	27.8	26.5	38.6	5.7
February ...	678.5	12.27	3.75	3.27	4.62	0.63	83.2	25.4	22.2	31.3	4.3
March	732.1	11.88	3.50	3.16	4.55	0.67	86.9	25.6	23.1	33.3	4.9
April	725.8	11.54	3.30	2.85	4.70	0.69	83.8	24.0	20.7	34.1	5.0
May	620.4	12.62	3.45	3.47	5.03	0.67	78.3	21.4	21.5	31.2	4.2
June	256.4	14.00	3.80	4.48	5.01	0.71	35.9	9.7	11.5	12.9	1.8
July	26.9	14.91	3.20	6.43	4.56	0.72	4.0	0.9	1.7	1.2	0.2

TABLE 57.

MISS FLOW 5TH — AYRSHIRE.

Third Period — Calved May 6, 1892.

MONTH.	Milk yield, pounds	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
May	605.4	13.59	3.78	3.13	6.01	0.67	82.3	22.9	18.9	36.4	4.1
June.......	905.2	12.69	3.00	2.96	6.13	0.60	114.9	27.2	26.8	55.5	5.4
July	917.6	11.88	2.79	2.79	5.58	0.72	109.0	25.6	25.6	51.2	6.6
August.....	792.7	12.81	3.47	3.63	5.07	0.64	101.5	27.5	28.8	40.2	5.0
September ..	692.1	12.72	3.18	3.19	5.72	0.63	88.0	22.0	22.1	39.6	4.3
October	715.9	13.54	3.34	3.49	5.93	0.78	96.9	23.9	25.0	42.4	5.6
November ..	614.6	13.44	3.89	3.63	5.23	0.69	82.6	23.9	22.3	32.2	4.2
December ..	505.8	14.35	4.21	3.88	5.52	0.74	72.6	21.3	19.6	27.9	3.8
1893.											
January	383.9	14.44	4.63	3.91	5.16	0.74	55.4	17.8	15.0	19.8	2.8
February ...	169.2	14.91	5.35	4.27	4.60	0.69	25.2	9.0	7.2	7.8	1.2

TABLE 58.

MANTON BELLE — AYRSHIRE.

Third Period — Calved November 21, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
November ..	281.4	13.73	4.03	3.66	5.30	0.74	38.6	11.3	10.3	14.9	2.1
December ..	1315.1	12.29	3.33	2.89	5.39	0.68	161.6	43.8	38.0	70.9	8.9
1893.											
January	1170.1	12.47	3.95	2.95	5.00	0.57	145.9	46.2	34.5	58.5	6.7
February ...	832.5	12.37	3.87	3.31	4.64	0.55	103.0	32.2	27.6	38.6	4.6
March	924.1	12.16	3.58	3.12	4.87	0.59	112.4	33.1	28.8	45.0	5.5
April	850.2	12.61	3.88	3.02	5.10	0.61	107.2	33.0	25.7	43.3	5.2
May	785.1	12.03	3.59	3.15	4.67	0.62	94.4	28.2	24.7	36.6	4.9
June	709.4	11.53	3.32	3.06	4.55	0.60	81.8	23.5	21.7	32.3	4.3
July	657.1	11.81	3.23	3.15	4.86	0.57	77.6	21.2	20.7	31.9	3.8
August.....	522.2	11.73	3.48	3.06	4.64	0.55	61.3	18.2	16.0	24.2	2.9
September ..	372.1	11.72	3.57	3.27	4.29	0.59	43.6	13.3	12.1	16.0	2.2
October	203.3	12.33	3.95	3.66	4.11	0.61	25.0	8.0	7.4	8.4	1.2
November ..	25.8	12.69	3.40	6.04	2.59	0.66	3.3	0.9	1.5	0.7	0.2

TABLE 59.

JUNIETTA PEERLESS — AYRSHIRE.

Third Period — Calved May 5, 1893.

MONTH.	Per cent. pounds	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1893.											
May	817.7	12.83	4.08	2.88	5.28	0.59	104.9	33.4	23.5	43.2	4.8
June.......	1055.8	11.26	3.24	2.69	4.79	0.54	118.9	34.2	28.4	50.6	5.7
July.......	1058.0	11.25	2.95	2.81	4.96	0.53	119.0	31.2	29.7	52.5	5.6
August	923.6	11.56	3.20	2.70	5.11	0.55	106.7	29.5	24.9	47.2	5.1
September..	955.5	11.52	2.85	2.90	5.21	0.56	110.1	27.2	27.7	49.8	5.4
October....	935.4	12.11	3.23	3.03	5.26	0.59	113.2	30.2	28.3	49.2	5.5
November..	874.8	12.49	3.72	2.99	5.21	0.57	109.3	32.5	26.2	45.6	5.0

TABLE 60.

GILDERBLOOM — JERSEY.

Third Period — Calved April 13, 1893.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1893. April	340.8	14.83	5.55	2.42	5.14	0.72	50.5	18.9	11.7	17.5	2.4
May	722.0	13.93	4.56	3.31	5.36	0.70	100.6	32.9	23.9	38.7	5.1
June	630.7	14.59	5.38	3.10	5.50	0.61	92.0	33.9	19.6	34.7	3.8
July	638.1	14.38	5.22	3.31	5.23	0.62	91.0	33.3	21.1	33.4	4.0
August	609.3	14.79	5.75	3.18	5.22	0.64	90.1	35.0	19.4	31.8	3.9
September..	611.7	14.67	5.30	3.58	5.12	0.67	89.7	32.4	21.9	31.3	4.1
October....	537.0	14.97	5.45	3.84	5.01	0.67	80.4	29.3	20.6	26.9	3.6
November..	467.4	15.53	5.95	3.93	4.94	0.71	72.6	27.8	18.4	23.1	3.3

TABLE 61.

COUNTESS FLAVIA — JERSEY.

Third Period — Calved November 12, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1892.											
November..	343.2	16.12	5.90	4.08	5.31	0.83	55.3	20.2	14.0	18.2	2.9
December ..	629.7	16.34	5.91	4.19	5.45	0.79	102.9	37.2	26.4	34.3	5.0
1893.											
January....	560.5	16.60	6.38	4.22	5.26	0.74	93.0	35.8	23.6	29.5	4.1
February...	477.1	16.09	6.25	4.22	4.90	0.72	76.7	29.8	20.1	23.4	3.4
March	521.4	16.09	6.05	3.98	5.35	0.71	83.9	31.5	20.8	27.9	3.7
April.......	496.4	16.11	6.20	3.99	5.20	0.72	80.0	30.8	19.8	25.8	3.6
May	479.8	16.12	6.32	4.06	5.02	0.72	77.3	30.3	19.5	24.1	3.4
June	396.6	16.03	6.05	4.07	5.21	0.70	63.6	24.0	16.1	20.7	2.8
July	363.2	15.82	6.08	3.89	5.19	0.66	57.5	22.1	14.1	18.9	2.4
August	248.6	15.99	5.95	3.86	5.49	0.69	39.7	14.8	9.6	13.6	1.7
September..	194.8	17.03	6.50	4.46	5.28	0.79	33.2	12.7	8.7	10.3	1.5

TABLE 62.

BARBARA ALLEN — JERSEY.

Third Period — Calved May 4, 1893.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1893.											
May	637.7	13.18	4.15	3.09	5.28	0.66	84.0	26.5	19.7	33.6	4.2
June	794.2	13.94	4.90	3.04	5.42	0.58	110.7	38.9	24.1	43.1	4.6
July	762.2	14.51	5.28	3.23	5.36	0.64	110.6	40.2	24.6	40.9	4.9
August ...	667.6	13.91	4.90	3.21	5.19	0.61	92.8	32.7	21.4	34.6	4.1
September..	728.9	14.21	4.90	3.38	5.35	0.58	103.5	35.7	24.6	39.0	4.2
October	624.5	15.41	6.00	3.71	5.07	0.63	96.2	37.5	23.2	31.6	3.9
November..	572.2	15.77	6.45	3.79	4.88	0.65	90.2	36.9	21.7	27.9	3.7

TABLE 63.

MAGGIE 6TH — AMERICAN-HOLDERNESS.

Third Period — Calved May 13, 1893.

MONTH.	Milk yield, pounds.	Per cent solids.	Per cent fat.	Per cent casein.	Per cent sugar.	Per cent ash	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash
1893.											
May	480.2	13.55	4.17	3.14	5.50	0.74	65.1	20.0	15.1	26.4	3.6
June.......	831.8	12.51	3.85	2.87	5.17	0.62	104.1	32.0	23.9	43.0	5.2
July	846.9	12.05	3.35	2.88	5.22	0.60	102.1	28.4	24.4	44.2	5.1
August	775.0	12.53	3.90	2.81	5.21	0.61	97.1	30.2	21.8	40.4	4.7
September..	773.6	12.68	3.62	3.10	5.29	0.67	98.1	28.0	24.0	40.9	5.2
October ...	695.7	12.77	3.85	3.24	5.01	0.67	88.8	26.8	22.5	34.9	4.6
November ..	633.0	13.27	4.18	3.35	5.07	0.67	84.0	26.5	21.2	32.1	4.2

TABLE 64.

NELLIE 6TH — AMERICAN-HOLDERNESS.

Third Period — Calved December 12, 1892.

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Pounds casein.	Pounds sugar.	Pounds ash.
1893.											
January....	765.1	12.69	3.78	3.15	5.03	0.73	97.1	28.9	24.1	38.5	5.6
February...	560.7	12.38	3.70	3.05	5.02	0.61	69.4	20.8	17.1	28.1	3.4
March	485.9	11.75	3.08	3.26	4.79	0.62	57.1	15.0	15.8	23.3	3.0
April	329.0	12.02	3.10	3.27	4.97	0.68	39.5	10.2	10.8	16.3	2.2
May	291.2	12.73	3.93	3.28	4.90	0.62	37.1	11.4	9.6	14.3	1.8
June.......	176.0	12.42	3.55	3.15	5.10	0.62	21.8	6.2	5.5	9.0	1.1
July	122.2	12.28	3.80	3.28	4.53	0.67	15.0	4.7	4.0	5.5	0.8
August	55.4	13.44	4.58	3.54	4.68	0.64	7.4	2.5	2.0	2.6	0.3

IONE — DEVON.

TABLE 65. *Third Period — Calved June 2, 1893.*

MONTH.	Milk yield, pounds.	Per cent. solids.	Per cent. fat.	Per cent. casein.	Per cent. sugar.	Per cent. ash.	Pounds solids.	Pounds fat.	Founds casein.	Pounds sugar.	Pounds ash.
1893.											
June	595.1	14.01	4.60	3.60	5.15	0.66	83.3	27.4	21.4	30.6	3.9
July.......	776.7	13.67	4.37	3.26	5.41	0.63	106.2	24.0	25.3	42.0	4.9
August	670.0	14.17	4.93	3.32	5.27	0.65	94.9	33.0	22.2	35.3	4.4
September..	692.7	14.53	4.93	3.62	5.28	0.70	100.6	34.1	25.1	36.6	4.8
October	574.4	14.97	5.30	3.77	5.19	0.71	86.0	30.4	21.7	29.8	4.1
November*.	211.3	16.31	6.20	4.01	5.36	0.74	34.5	13.1	8.5	11.3	1.6

* Ione died November 14, 1893.

TABLE 66. CRUDE FATS IN FOOD CONSUMED EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian........	Tolsma Artis..............	35.3	47.5	53.3	40.8	40.1	43.7	33.0	35.1	41.4	43.6	37.8	33.6	....
Ayrshire................	Miss Flow 5th.............	19.1	35.8	45.3	48.7	44.2	48.1	37.2	33.5	34.2	24.7	....	....	....
Ayrshire................	Manton Belle.............	7.9	37.3	44.6	33.6	38.5	44.3	44.2	38.2	38.5	44.8	44.5	29.8	16.6
Ayrshire................	Junietta Peerless.........	23.9	34.6	36.7	47.5	52.3	43.4	32.5	....	....	....	....	....	....
Jersey..................	Gilderbloom..............	11.9	30.1	30.7	33.0	39.1	45.2	35.8	25.4	....	....	....	....	....
Jersey..................	Countess Flavia..........	13.9	29.6	33.4	30.3	32.1	35.8	32.6	29.2	27.3	25.8	31.3	....	....
Jersey..................	Barbara Allen............	24.4	33.8	35.9	44.0	51.0	39.5	30.8	....	....	....	....	....	....
American-Holderness...	Maggie 6th...............	13.7	28.8	34.5	45.1	49.9	39.9	28.5	....	....	....	....	....	....
American-Holderness...	Nellie 6th................	26.1	21.2	23.3	26.5	22.8	23.8	18.8	21.4	....	....	....	....	....
Devon..................	Ione......................	23.5	29.4	38.8	45.2	36.8	....	....	....	....	....	....	....	....
	Average..............	20.0	32.8	37.6	39.5	40.7	40.4	32.6	30.5	35.3	34.7	37.9	31.7	16.6

TABLE 67. ALBUMINOIDS NOT AMIDES IN FOOD CONSUMED EACH MONTH OF THIRD PERIOD OF LACTATION—POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian......	Tolsma Artis................	71.37	110.31	94.62	78.37	112.19	109.31	75.75	77.75	66.62	71.62	86.06	74.19	....
Ayrshire	Miss Flow 5th..............	26.44	70.44	76.25	105.56	102.06	85.75	75.31	93.94	83.31	59.87	......	......	....
Ayrshire	Manton Belle	18.69	107.00	115.69	84.31	98.75	83.12	83.94	91.62	95.19	84.81	78.94	52.62	32.31
Ayrshire	Junietta Peerless	41.87	83.37	93.94	90.44	100.12	82.06	65.56	......	......	......	......	......	....
Jersey	Gilderbloom	19.00	51.06	73.62	82.87	74.37	81.44	68.44	50.44	......	......	......	......	....
Jersey	Countess Flavia.............	33.06	89.44	87.50	84.19	87.19	68.87	63.12	67.50	60.50	53.44	54.75	......	....
Jersey	Barbara Allen	43.06	81.75	91.94	83.94	91.25	73.81	61.75	......	......	......	......	......	....
American-Holderness..	Maggie 6th..................	26.25	69.25	87.87	86.06	91.19	78.00	58.50	......	......	......	......	......	....
American-Holderness.	Nellie 6th	80.00	63.25	71.06	56.06	48.00	47.44	46.44	40.62	......	......	......	......	....
Devon	Ione........................	54.19	73.25	73.69	81.25	70.00	......	......	......	......	......	......	......	....
	Average	41.39	79.91	86.62	83.30	87.51	78.87	66.53	70.31	76.40	67.43	73.28	63.40	32.31

TABLE 68. CARBOHYDRATES IN FOOD CONSUMED EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Thir .	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian........	Tolsma Artis..............	303.6	408.8	541.2	450.4	497.6	472.7	357.8	382.3	393.8	417.3	324.2	255.8	....
Ayrshire.................	Miss Flow 5th.............	230.1	301.2	408.5	411.1	369.9	488.9	411.6	418.5	370.6	276.0	....	....	....
Ayrshire.................	Manton Belle..............	108.1	463.6	482.3	366.6	418.8	441.3	441.7	355.9	356.2	344.2	388.2	315.4	218.2
Ayrshire.................	Junietta Peerless.........	230.1	323.5	355.3	363 6	453.9	437.8	404.4	....	....	....	....	....	....
Jersey...................	Gilderbloom...............	114.5	293.4	284.7	313 5	297.4	395.3	361.2	329.8	....	....	....	....	....
Jersey...................	Countess Flavia...........	182.0	372.4	361 0	320.4	341.1	360.8	328.6	256.3	206.8	210 6	313.0	....	....
Jersey...................	Barbara Allen.............	235.1	318.0	350.0	335.7	443.2	405.9	388.7	....	....	....	....	....	....
American-Holderness....	Maggie 6th................	133.5	265.3	332.9	344.8	427.3	394.2	337.4	....	....	....	....	....	....
American-Holderness ...	Nellie 6th................	280.7	205.4	234.2	280.1	237.6	185.2	171.9	159.7	....	....	....	....	....
Devon....................	Ione......................	207.1	278.4	295.2	394.9	377.5	....	....	....	....	....	....	....	....
	Average..............	202 5	323.0	364.5	358.1	386.4	398.0	355.9	317.1	331.8	312.0	341.8	285.6	218.2

TABLE 69. STARCH AND SUGARS IN FOOD CONSUMED EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Third	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	Tolsma Artis	170.8	250.2	327.8	260.2	267.0	235.0	238.3	252.7	293.1	292.6	208.5	137.2	....
Ayrshire	Miss Flow 5th	165.8	199.2	254.6	240.8	222.3	294.9	235.7	227.2	185.2	179.3	....	....	....
Ayrshire	Manton Belle	60.4	251.6	244.9	244.1	280.5	344.1	344.4	248.1	242.7	198.4	236.0	177.5	92.0
Ayrshire	Junietta Peerless	169.8	227.0	253.2	215.4	280.6	258.8	210.4	....	....	....	....	....	....
Jersey	Gilderbloom	86.6	225.0	198.1	219.3	174.9	210.5	211.1	168.9	....	....	....	....	....
Jersey	Countess Flavia	99.5	217.0	183.2	222.0	234.6	285.4	259.0	168.5	111.5	123.7	176.2	....	....
Jersey	Barbara Allen	172.4	223.8	250.7	195.3	171.9	237.3	200.7	....	....	....	....	....	....
American-Holderness	Maggie 6th	95.6	184.0	236.8	206.9	265.8	234.3	180.5	....	....	....	....	....	....
American-Holderness	Nellie 6th	144.5	155.9	172.2	233.9	194.0	136.3	117.6	91.3	....	....	....	....	....
Devon	Ione	137.6	192.0	176.8	240.6	222.2	....	....	....	....	....	....	....	....
	Average	129.3	212.6	229.8	227.8	241.4	251.8	222.0	192.8	208.1	198.5	206.9	157.3	92.0

TABLE 70. CRUDE FIBER IN FOOD CONSUMED EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian........	Tolsma Artis	149.5	171.1	185.7	147.0	141.1	181.4	136.7	165.0	145.1	151.4	172.2	169.2	....
Ayrshire	Miss Flow 5th..............	103.4	137.8	186.4	184.3	159.7	168.8	133.8	116.3	148.7	121.9	....	....	....
Ayrshire	Manton Belle	34.1	130.2	184.5	152.6	171.5	145.4	145.7	166.8	175.0	174.0	148.8	110.1	129.1
Ayrshire	Junietta Peerless	87.7	149.9	157.1	172.3	166.5	130.6	148.3	....	....	....	....	....	....
Jersey...................	Gilderbloom	43.5	100.1	133.8	147.3	143.2	149.0	108.3	124.5	....	....	....	....	....
Jersey...................	Countess Flavia	56.5	99.2	136.3	118.6	129.4	114.1	105.2	131.8	136.6	128.3	140.7	....	....
Jersey...................	Barbara Allen	90.8	146.5	157.1	166.1	164.1	125.1	146.1	....	....	....	....	....	....
American-Holderness ...	Maggie 6th.................	55.3	124.8	152.2	158.2	152.2	111.5	118.7	....	....	....	....	....	....
American-Holderness ...	Nellie 6th..................	85.5	55.2	70.7	73.9	68.5	78.0	85.4	81.9	....	....	....	....	....
Devon	Ione	105.0	132.6	143.4	148.7	111.5	....	....	....	....	....	....	....	....
	Average	81.1	114.8	150.7	146.9	140.8	133.8	125.4	131.0	151.3	143.9	153.9	139.6	129.1

TABLE 71. ASH IN FOOD CONSUMED EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian......	Tolsma Artis................	39.0	53.8	41.1	45.7	47.4	42.6	39.0	41.7	35.3	37.3	47.2	45.5	....
Ayrshire	Miss Flow 5th	25.1	44.1	49.7	53.7	51.0	37.3	41.5	40.1	33.7	31.1	....	....	....
Ayrshire	Manton Belle................	14.8	44.4	43.8	40.8	46.6	38.8	38.9	47.2	50.6	44.5	35.5	36.5	24.3
Ayrshire	Junietta Peerless	22.5	42.8	47.7	45.5	40.7	47.6	38.6	....	....	....	....	....	....
Jersey	Gilderbloom	11.2	25.7	38.1	43.1	38.2	36.5	41.8	31.9	....	....	....	....	....
Jersey	Countess Flavia.............	24.4	36.0	32.7	35.4	37.7	31.4	28.7	36.4	37.1	35.1	32.6	....	....
Jersey	Barbara Allen...............	23.3	41.8	46.8	43.3	40.0	45.1	37.4	....	....	....	....	....	....
American-Holderness..	Maggie 6th..................	15.0	35.7	45.1	42.3	38.4	44.4	31.6	....	....	....	....	....	....
American-Holderness..	Nellie 6th	24.8	21.3	25.2	23.2	20.3	23.4	24.9	22.3	....	....	....	....	....
Devon	Ione........................	29.7	38.4	38.0	36.4	42.9	....	....	....	....	....	....	....	....
	Average	23.0	38.4	40.8	40.9	40.3	38.6	35.8	36.6	39.2	37.0	38.4	41.0	24.3

TABLE 72. MILK YIELD EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian........	Tolsma Artis..............	705.5	1062.2	1092.8	927.9	919.1	813.3	678.5	732.1	725.8	620.4	256.4	26.9	....
Ayrshire	Miss Flow 5th.............	605.4	905.2	917.6	792.7	692.1	715.9	614.6	505.8	383.9	169.2	....	....	....
Ayrshire	Manton Belle..............	281.4	1315.1	1170.1	832.5	924.1	850.2	785.1	709.4	657.1	522.2	372.1	203.3	25.8
Ayrshire	Junietta Peerless	817.7	1055.8	1058.0	923.6	955.5	935.4	874.8	....	....	....	....	....	....
Jersey	Gilderbloom	340.8	722.0	630.7	638.1	609.3	611.7	537.0	467.4	....	....	....	....	....
Jersey	Countess Flavia...........	343.2	629.7	560.5	477.1	521.4	496.4	479.8	396.6	363.2	248.6	194.8	....	....
Jersey	Barbara Allen	637.7	794.2	762.2	667.6	728.9	624.5	572.2	....	....	....	....	....	....
American-Holderness ...	Maggie 6th................	480.2	831.8	846.9	775.0	773.6	695.7	633.0	....	....	....	....	....	....
American-Holderness ...	Nellie 6th................	765.1	560.7	485.9	329.0	291.2	176.0	122.2	55.4	....	....	....	....	....
Devon	Ione......................	595.1	776.7	670.0	692.7	574.4	....	....	....	....	....	....	....	....
	Average...............	557.2	865.3	819.5	705.6	699.0	657.7	588.6	477.8	532.5	390.1	274.4	115.1	25.8

TABLE 73. TOTAL SOLIDS IN MILK EACH MONTH OF THIRD PERIOD OF LACTATION — PER CENT.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	Tolsma Artis	11.15	10.54	10.65	11.20	11.95	12.12	12.27	11.88	11.54	12.62	14.00	14.91	....
Ayrshire	Miss Flow 5th	13.59	12.69	11.88	12.81	12.72	13.54	13.44	14.35	14.44	14.91	....	....	....
Ayrshire	Manton Belle	13.73	12.29	12.47	12.37	12.16	12.61	12.03	11.53	11.81	11.73	11.72	12.33	12.69
Ayrshire	Junietta Peerless	12.83	11.26	11.25	11.56	11.82	12.11	12.49	....	....	....	....	....	....
Jersey	Gilderbloom	14.83	13.93	14.59	14.38	14.79	14.67	14.97	15.53	....	....	....	....	....
Jersey	Countess Flavia	16.12	16.34	16.60	16.09	16.09	16.11	16.12	16.03	15.82	15.99	17.03	....	....
Jersey	Barbara Allen	13.18	13.94	14.51	13.91	14.21	15.41	15.77	....	....	....	....	....	....
American-Holderness	Maggie 6th	13.55	12.51	12.05	12.53	12.68	12.77	13.27	....	....	....	....	....	....
American-Holderness	Nellie 6th	12.69	12.38	11.75	12.02	12.73	12.42	12.28	13.44	....	....	....	....	....
Devon	Ione	14.01	13.67	14.17	14.53	14.97	....	....	....	....	....	....	....	....
	Average	13.57	12.96	12.99	13.14	13.38	13.53	13.63	13.79	13.40	13.81	14.25	13.62	12.69

TABLE 74. FAT IN MILK EACH MONTH OF THIRD PERIOD OF LACTATION — PER CENT.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	Tolsma Artis	3.21	2.58	2.65	2.66	3.09	3.42	3.75	3.50	3.30	3.45	3.80	3.20	....
Ayrshire	Miss Flow 5th	3.78	3.00	2.79	3.47	3.18	2.34	3.89	4.21	4.63	5.35	....	....	....
Ayrshire	Manton Belle	4.03	3.33	3.95	3.87	3.58	3.88	3.59	3.32	3.23	3.48	3.57	3.95	3.40
Ayrshire	Junietta Peerless	4.08	3.24	2.95	3.20	2.85	3 23	3.72	....	....	....	....	....	....
Jersey	Gilderbloom	5.55	4.56	5.38	5.22	5.75	5.30	5.45	5.95	....	....	....	....	....
Jersey	Countess Flavia	5.90	5.91	6.38	6.25	6.05	6.20	6.32	6.05	6.08	5.95	6.50	....	....
Jersey	Barbara Allen	4.15	4.90	5.28	4.90	4.90	6.00	6.45	....	....	....	....	....	....
American-Holderness	Maggie 6th	4.17	3.85	3.35	3.90	3.62	3.85	4.18	....	....	....	....	....	....
American-Holderness.	Nellie 6th	3.78	3.70	3.08	3.10	3.93	3.55	3.80	4.58	....	....	....	....	....
Devon	Ione	4.60	4.37	4.93	4.93	5.30	....	....	....	....	....	....	....	....
	Average	4.33	3.94	4.07	4.15	4.22	4.31	4.57	4.60	4.31	4.56	4.62	3.57	3.40

TABLE 75. CASEIN IN MILK EACH MONTH OF THIRD PERIOD OF LACTATION — PER CENT.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	Tolsma Artis	2.52	2.43	2.55	2.86	3.14	3.26	3.27	3.16	2.85	3.47	4.48	6.43	....
Ayrshire	Miss Flow 5th	3.13	2.96	2.79	3.63	3.19	3.49	3.63	3.88	3.91	4.27	....	....	....
Ayrshire	Manton Belle	3.66	2.89	2.95	3.31	3.12	3.02	3.15	3.06	3.15	3.06	3.27	3.66	6.04
Ayrshire	Junietta Peerless	2.88	2.69	2.81	2.70	2.90	3.03	2.99	....	....	....	....	....	....
Jersey	Gilderbloom	3.42	3.31	3.10	3.31	3.18	3.58	3.84	3.93	....	....	....	....	....
Jersey	Countess Flavia	4.08	4.19	4.22	4.22	3.98	3.89	4.06	4.07	3.89	3.86	4.46	....	....
Jersey	Barbara Allen	3.09	3.04	3.23	3.21	3.38	3.71	3.79	....	....	....	....	....	....
American-Holderness	Maggie 6th	3.14	2.87	2.88	2.81	3.10	3.24	3.35	....	....	....	....	....	....
American-Holderness	Nellie 6th	3.15	3.05	3.26	3.27	3.28	3.15	3.28	3.54	....	....	....	....	....
Devon	Ione	3.60	3.26	3.32	3.62	3.77	....	....	....	....	....	....	....	....
	Average	3.27	3.07	3.11	3.29	3.30	3 38	3.58	3.61	3.45	3.66	4.07	5.04	6.04

TABLE 76. SUGAR IN MILK EACH MONTH OF THIRD PERIOD OF LACTATION — PER CENT.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian........	Tolsma Artis..............	4.87	4.98	4.76	4.94	5.05	4.74	4.62	4.55	4.70	5.03	5.01	4.56	....
Ayrshire	Miss Flow 5th............	6.01	6.13	5.58	5.07	5.72	5.93	5.23	5 52	5.16	4.60	....	....	....
Ayrshire	Manton Belle..............	5.30	5.39	5 00	4.64	4.87	5.10	4.67	4.55	4.86	4.64	4.29	4.11	2.59
Ayrshire	Junietta Peerless	5.28	4.79	4.96	5.11	5.21	5.26	5.21	....	....	....	....	....	....
Jersey..................	Gilderbloom...............	5.14	5.36	5.50	5.23	5.22	5.12	5.01	4.94	....	....	....	....	....
Jersey..................	Countess Flavia...........	5.31	5.45	5.26	4.90	5.35	5.20	5.02	5.21	5.19	5.49	5.28	....	....
Jersey..................	Barbara Allen	5.28	5.42	5.36	5.19	5.35	5.07	4.88	....	....	....	....	....	....
American-Holderness ...	Maggie 6th................	5.50	5.17	5.22	5.21	5.29	5.01	5.07	....	....	....	....	....	....
American-Holderness ...	Nellie 6th	5.03	5.02	4.79	4.97	4.90	5.10	4.53	4.68	....	....	....	....	....
Devon..................	Ione......................	5.15	5.41	5.27	5.28	5.19	....	....	....	....	....	....	....	....
	Average	5.29	5.31	5.17	5.05	5.22	5.17	4.91	4.91	4.98	4.94	4.89	4.33	2.59

TABLE 77. ASH IN MILK EACH MONTH OF THIRD PERIOD OF LACTATION — PER CENT.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian........	Tolsma Artis..............	0.55	0.55	0.69	0.74	0.67	0.70	0.63	0.67	0.69	0.67	0.71	0.72	....
Ayrshire	Miss Flow 5th.............	0.67	0.60	0.72	0.64	0.63	0.73	0.69	0.74	0.74	0.69	....	....	....
Ayrshire	Manton Belle	0.74	0.68	0.57	0.55	0.59	0.61	0.62	0.60	0.57	0.55	0.59	0.61	0.66
Ayrshire	Junietta Peerless	0.59	0.54	0.53	0.55	0.56	0.59	0.57	....	....	....	....	....	....
Jersey..................	Gilderbloom...............	0.72	0.70	0.61	0.62	0.64	0.67	0.67	0.71	....	....	....	....	....
Jersey,.................	Countess Flavia...........	0.83	0.79	0.74	0.72	0.71	0.72	0.72	0.70	0.66	0.69	0.79	....	....
Jersey..................	Barbara Allen	0.66	0.58	0.64	0.61	0.58	0.63	0.65	....	....	....	....	....	....
American-Holderness ...	Maggie 6th...............	0.74	0.62	0.60	0.61	0.67	0.67	0.67	....	....	....	....	....	....
American-Holderness ...	Nellie 6th	0.73	0.61	0.62	0.68	0.62	0.62	0.67	0.64	....	....	....	....	....
Devon..................	Ione......................	0.66	0.63	0.65	0.70	0.71	....	....	....	....	....	....	....	....
	Average	0.69	0.63	0.64	0.64	0.64	0.67	0.66	0.68	0.66	0.65	0.70	0.66	0.66

TABLE 78. Total Solids in Milk Each Month of Third Period of Lactation — Pounds.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian........	Tolsma Artis..............	78.7	111.9	116.4	103.9	109.8	98.6	83.2	86.9	83.8	78.3	35.9	4.0	....
Ayrshire.................	Miss Flow 5th	82.3	114.9	109.0	101.5	88.0	96.9	82.6	72.6	55.4	25.2	....	....	....
Ayrshire.................	Manton Belle..............	38.6	161.6	145.9	103.0	112.4	107.2	94.4	81.8	77.6	61.3	43.6	25.0	3.3
Ayrshire.................	Junietta Peerless..........	104.9	118.9	119.0	106.7	110.1	113.2	109.3	....	....	....	....	....	....
Jersey	Gilderbloom..............	50.5	100.6	92.0	91.8	90.1	89.7	80.4	72.6	....	....	....	....	....
Jersey	Countess Flavia...........	55.3	102.9	93.0	76.7	83.9	80.0	77.3	63.6	57.5	39.7	33.2	....	....
Jersey	Barbara Allen.............	84.0	110.7	110.6	92.8	103.5	96.2	90.2	....	....	....	....	....	....
American-Holderness ...	Maggie 6th	65.1	104.1	102.1	97.1	98.1	88.8	84.0	....	....	....	....	....	....
American-Holderness....	Nellie 6th.................	97.1	69.4	57.1	39.5	37.1	21.8	15.0	7.4	....	....	....	....	....
Devon	Ione......................	83.3	106.2	94.9	100.6	86.0	....	....	....	....	....	....	....	....
	Average...............	74.0	110.1	104.0	91.4	91.9	88.0	79.6	64.1	68.6	51.1	37.6	14.5	3.3

TABLE 79. FAT IN MILK EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	Toloma Artis	22.6	27.4	29.0	24.7	28.4	27.8	25.4	25.6	24.0	21.4	9.7	0.9	....
Ayrshire	Miss Flow 5th	22.9	27.2	25.6	27.5	22.0	23.9	23.9	21.3	17.8	9.0	....	....	....
Ayrshire	Manton Belle	11.3	43.8	46.2	32.2	33.1	33.0	28.2	23.5	21.2	18.2	13.3	8.0	0.9
Ayrshire	Junietta Peerless	33.4	34.2	31.2	29.5	27.2	30.2	32.5	....	....	....	....	....	....
Jersey	Gilderbloom	18.9	32.9	33.9	33.3	35.0	32.4	29.3	27.8	....	....	....	....	....
Jersey	Countess Flavia	20.2	37.2	35.8	29.8	31.5	30.8	30.3	24.0	22.1	14.8	12.7	....	....
Jersey	Barbara Allen	26.5	38.9	40.2	32.7	35.7	37.5	36.9	....	....	....	....	....	....
American-Holderness	Maggie 6th	20.0	32.0	28.4	30.2	28.0	26.8	26.5	....	....	....	....	....	....
American-Holderness	Nellie 6th	28.9	20.8	15.0	10.2	11.4	6.2	4.7	2.5	....	....	....	....	....
Devon	Ione	27.4	24.0	33.0	34.1	30.4	....	....	....	....	....	....	....	....
	Average	23.2	31.8	31.8	28.4	28.3	27.6	26.4	20.8	21.3	15.8	11.9	4.4	0.9

TABLE 80. CASEIN IN MILK EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian........	Tolsma Artis..............	17.8	25.8	27.9	26.5	28.9	26.5	22.2	23.1	20.7	21.5	11.5	1.7	....
Ayrshire.................	Miss Flow 5th............	18.9	26.8	25.6	28.8	22.1	25.0	22.3	19 6	15.0	7.2	....	....	....
Ayrshire.................	Manton Belle	10.3	38.0	34.5	27.6	28.8	25.7	24.7	21.7	20.7	16.0	12.1	7.4	1 .5
Ayrshire.................	Junietta Peerless	23.5	28.4	29.7	24.9	27.7	28.3	26.2	....	....	....	....	....	....
Jersey	Gilderbloom	11.7	23.9	19.6	21.1	19.4	21.9	20.6	18.4	....	....	....	....	....
Jersey	Countess Flavia..........	14.0	26.4	23.6	20.1	20.8	19.8	19.5	16.1	14.1	9.6	8.7	....	....
Jersey	Barbara Allen	19.7	24.1	24.6	21.4	24.6	22.2	21.7	....	....	....	....	....	....
American-Holderness ...	Maggie 6th................	15.1	23.9	24.4	21.8	24.0	22.5	21.2	....	....	....	....	....	....
American-Holderness ...	Nellie 6th	24.1	17.1	15.8	10.8	9.6	5.5	4.0	2.0	....	....	....	....	....
Devon	Ione	21.4	25.3	22.2	25.1	21.7	....	....	....	....	....	....	....	....
	Average	17.7	26.0	24.8	22.8	22.8	22.0	20.3	16.8	17.6	13.6	10.8	4.5	1.5

TABLE 81. SUGAR IN MILK EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian........	Tolsma Artis..............	34.4	52.9	52.0	45.8	46.4	38.6	31.3	33.3	34.1	31.2	12.9	1.2	....
Ayrshire	Miss Flow 5th.............	36.4	55.5	51.2	40.2	39.6	42.4	32.2	27.9	19.8	7.8	....	....	....
Ayrshire	Manton Belle	14.9	70.9	58.5	38.6	45.0	43.3	36.6	32.3	31.9	24.2	16.0	8.4	0.7
Ayrshire	Junietta Peerless	43.2	50.6	52.5	47.2	49.8	49.2	45.6	....	....	....	....	....	....
Jersey..................	Gilderbloom	17.5	38.7	34.7	33.4	31.8	31.3	26.9	23.1	....	....	....	....	....
Jersey..................	Countess Flavia...........	18.2	34.3	29.5	23.4	27.9	25.8	24.1	20.7	18.9	13.6	10.3	....	....
Jersey..................	Barbara Allen	33.6	43.1	40.9	34.6	39.0	31.6	27.9	....	....	....	....	....	....
American-Holderness ...	Maggie 6th................	26.4	43.0	44.2	40.4	40.9	34.9	32.1	....	....	....	....	....	....
American-Holderness ...	Nellie 6th	38.5	28.1	23.3	16.3	14.3	9.0	5.5	2.6	....	....	....	....	....
Devon	Ione......................	30.6	42.0	35.3	36.6	29.8	....	....	....	....	....	....	....	....
	Average	29.4	45.9	42.2	35.7	36.5	34.0	29.1	23.3	26.2	19.2	13.1	4.8	0.

TABLE 82. ASH IN MILK EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

Breed.	NAME OF ANIMAL.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian........	Tolsma Artis.............	3.9	5.8	7.5	6.9	6.1	5.7	4.3	4.9	5.0	4.2	1.8	0.2	....
Ayrshire.................	Miss Flow 5th............	4.1	5.4	6.6	5.0	4.3	5.6	4.2	3.8	2.8	1.2	....	....	....
Ayrshire.................	Manton Belle.............	2.1	8.9	6.7	4.6	5.5	5.2	4.9	4.3	3.8	2.9	2.2	1.2	0.2
Ayrshire.................	Junietta Peerless..........	4.8	5.7	5.6	5.1	5.4	5.5	5.0	....	....	....	....	....	....
Jersey...................	Gilderbloom...............	2.4	5.1	3.8	4.0	3.9	4.1	3.6	3.3	....	....	....	....	....
Jersey...................	Countess Flavia...........	2.9	5.0	4.1	3.4	3.7	3.6	3.4	2.8	2.4	1.7	1.5	....	....
Jersey...................	Barbara Allen.............	4.2	4.6	4.9	4.1	4.2	3.9	3.7	....	....	....	....	....	....
American-Holderness ...	Maggie 6th................	3.6	5.2	5.1	4.7	5.2	4.6	4.2	....	....	....	....	....	....
American-Holderness ...	Nellie 6th.................	5.6	3.4	3.0	2.2	1.8	1.1	0.8	0.3	....	....	....	....	....
Devon....................	Ione......................	3.9	4.9	4.4	4.8	4.1	....	....	....	....	.....	....	....	....
	Average	3.8	5.4	5.2	4.5	4.4	4.4	3.8	3.2	3.5	2.5	1.8	0.7	0.2

TABLE 83. AVERAGE CRUDE FATS IN FOOD CONSUMED BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION—POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	35.3	47.5	53.3	40.8	40.1	43.7	33.0	35.1	41.4	43.6	37.8	33.6	....
Ayrshire..................	17.0	35.9	42.2	43.3	45.0	45.3	38.0	35.8	36.3	34.7	44.5	29.8	16.6
Jersey	16.7	31.2	33.3	35.8	40.7	40.2	33.1	27.3	27.3	25.8	31.3	....	....
American-Holderness	19.9	25.0	28.9	35.8	36.3	31.8	23.6	21.4	....	....	....	....	....
Devon	23.5	29.4	38.8	45.2	36.8	....	....	....	....	....	....	....	....
Average	22.5	33.8	39.3	40.2	39.8	40.2	31.9	29.9	35.0	34.7	37.9	31.7	16.6

TABLE 84. AVERAGE ALBUMINOIDS NOT AMIDES IN FOOD CONSUMED BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	71.37	110.31	94.62	78.37	112.19	109.31	75.75	77.75	66.62	71.62	86.06	74.19	....
Ayrshire	29.00	86.94	95.29	93.44	100.31	83.64	74.94	92.78	89.25	72.34	78.94	52.62	32.31
Jersey....................	31.71	74.08	84.35	83.67	84.27	74.71	64.44	58.97	60.50	53.44	54.75	....	....
American-Holderness....	53.12	66.25	79.46	71.06	69.59	62.72	52.47	40.62	....	....	....	....	....
Devon....................	54.19	73.25	73.69	81.25	70.00	....	....	....	....	....	....	....	....
Average.............	47.88	82.17	85.48	81.56	87.27	82.59	66.90	67.53	72.12	65.80	73.25	63.40	32.31

TABLE 85. AVERAGE CARBOHYDRATES IN FOOD CONSUMED BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION—POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	303.6	408.8	541.2	450.4	497.6	472.7	357.8	382.3	393.8	417.3	324.2	255.8	....
Ayrshire..................	189.4	362.8	415.4	380.4	414.2	456.0	419.2	387.2	363.4	310.1	388.2	315.4	218.2
Jersey	177.2	327.9	331.9	323.2	360.6	387.3	359.5	293.0	206.8	210.6	313.0	....	....
American-Holderness	207.1	235.3	283.6	312.4	332.4	289.7	254.6	159.7	....	....	....	....	....
Devon	207.1	278.4	295.2	394.9	377.5	....	....	....	....	....	....	....	....
Average	216.9	322.6	373.5	372.3	396.5	401.4	347.8	305.5	321.3	312.7	341.8	285.6	218.2

TABLE 86. Average Sugar and Starch in Food Consumed by Brreds Each Month of Third Period of Lactation — Pounds.

BREEDS.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	170.8	250.2	327.8	260.2	267.0	235.0	238.3	252.7	293.1	292.6	208.5	137.2	....
Ayrshire.....	132.0	225.9	250.9	233.4	261.1	299.3	263.5	237.6	213.9	188.8	236.0	177.5	92.0
Jersey	119.5	221.9	210.7	212.2	227.1	254.4	223.6	168.7	111.5	123.7	176.2	....	....
American-Holderness	120.0	169.9	204.5	220.4	229.9	185.3	149.0	91.3	....	....	....	....	....
Devon....................	137.6	192.0	176.8	240.6	222.2	....	....	....	....	....	....	....	....
Average	136.0	212.0	234.1	233.4	241.5	243.5	218.6	187.6	206.2	201.7	206.9	157.3	92.0

TABLE 87. AVERAGE CRUDE FIBER IN FOOD CONSUMED BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth
Holstein-Friesian.........	149.5	171.1	185.7	147.0	141.1	181.4	136.7	165.0	145.1	151.4	172.2	169.2	....
Ayrshire..................	75.1	139.3	176.0	169.7	165.9	148.3	142.6	141.5	161.8	147.9	148.8	110.1	129.1
Jersey....................	63.6	115.3	142.4	144.0	145.6	129.4	119.9	128.1	136.6	128.3	140 7	....	....
American-Holderness.....	70.4	90.0	111.4	116.0	110.3	94.7	102.0	81.9	....	....	....	....	....
Devon.....................	105.0	133.6	143.4	148.7	111.5	....	....	....	....	....	....	....	....
Average..............	92.7	129.8	151.8	145.1	134.9	138.4	125.3	129.1	147.8	142.5	153.9	139.6	129.1

TABLE 88. AVERAGE ASH IN FOOD CONSUMED BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh	Twelfth.	Thirteenth.
Holstein-Friesian	39.0	53.8	41.1	45.7	47.4	42.6	39.0	41.7	35.3	37.3	47.2	45.5	....
Ayrshire	20.8	43.8	47.1	46.7	46.1	41.2	39.7	43.6	42.1	35.2	35.5	36.5	24.3
Jersey	19.6	34.5	39.2	40.6	38.6	37.7	36.0	34.1	37.1	35.1	32.6	....	....
American-Holderness.....	19.9	28.5	35.1	32.7	29.3	33.9	28.2	22.3	....	....	....	....	....
Devon	29.7	38.4	38.0	36.4	42.9	....	....	....	....	....	....	....	....
Average	25.8	39.8	40.1	40.4	40.9	38.8	35.7	35.4	38.2	35.9	38.4	41.0	24.3

TABLE 89. AVERAGE MILK YIELD BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION—POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	705.5	1062.2	1092.8	927.9	919.1	813.3	678.5	732.1	725.8	620.4	256.4	26.9	....
Ayrshire	568.2	1093.0	1048.6	849.6	857.2	833.8	758.2	607.6	520.5	345.7	372.1	203.3	25.8
Jersey	440.5	715.3	651.1	594.3	619.9	577.5	529.7	432.0	363.2	248.6	194.8	....	....
American-Holderness	622.6	696.2	666.4	552.0	532.4	435.8	377.6	55.4	....	....	....	....	....
Devon	595.1	776.7	670.0	692.7	574.4	....	....	....	....	....	....	....	....
Average	586.4	868.7	825.8	723.3	700.6	665.1	586.0	456.8	536.5	404.9	274.4	115.1	25.8

TABLE 90. AVERAGE TOTAL SOLIDS IN MILK BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	11.15	10.54	10.65	11.20	11.95	12.12	12.27	11.88	11.54	12.62	14.00	14.91	....
Ayrshire	13.38	12.08	11.83	12.25	12.13	12.75	12.65	12.94	13.12	13.32	11.72	12.33	12.69
Jersey	14.71	14.74	15.23	14.79	15.03	15.40	15.62	15.78	15.82	15.99	17.03	....	....
American-Holderness	13.12	12.44	11.90	12.27	12.70	12.59	12.77	13.44	....	....	....	....	....
Devon....................	14.01	13.67	14.17	14.53	14.97	....	....	....	....	....	....	....	....
Average	13.27	12.69	12.76	13.01	13.36	13.46	13.32	13.51	13.49	13.98	14.25	13.62	12.69

TABLE 91. AVERAGE FAT IN MILK BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	3.21	2.58	2.65	2.66	3.09	3.42	3.75	3.50	3.30	3.45	3.80	3.20	....
Ayrshire	3.96	3.19	3.23	3.51	3.20	3.48	3.73	3.76	3.93	4.41	3.57	3.95	3.40
Jersey	5.20	5.12	5.68	5.46	5.57	5.83	6.07	6.00	6.08	5.95	6.50	....	....
American-Holderness	3.97	3.77	3.21	3.50	3.77	3.70	3.99	4.58	....	....	....	....	....
Devon	4.60	4.37	4.93	4.93	5.30	....	....	....	....	....	....	....	....
Average	4.19	3.81	3.94	4.01	4.19	4.11	4 39	4.46	4.44	4.60	4.62	3.57	3.40

TABLE 92. AVERAGE CASEIN IN MILK BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	2.52	2.43	2.55	2.86	3.14	3.26	3.27	3.16	2.85	3.47	4.48	6.43	....
Ayrshire	3.22	2.85	2.85	3.21	3.07	3.18	3.26	3.47	3.53	3.66	3.27	3.66	6.04
Jersey	3.53	3.51	3.52	3.58	3.51	3.76	3.90	4.00	3.89	3.86	4.46	....	....
American-Holderness	3.14	2.96	3.07	3.04	3.19	3.19	3.31	3.54	....	....	....	....	....
Devon	3.60	3.26	3.32	3.62	3.77	....	....	....	....	....	....	....	....
Average	3.20	3.00	3.06	3.26	3.34	3.35	3.43	3.54	3.42	3.66	4.07	5.04	6.04

TABLE 93. AVERAGE SUGAR IN MILK BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	4.87	4.98	4.76	4.94	5.05	4.74	4.62	4.55	4.70	5.03	5.01	4.56	....
Ayrshire	5.53	5.44	5.18	4.94	5.27	5.43	5.04	5.03	5.01	4.62	4.29	4.11	2.59
Jersey	5.24	5.41	5.37	5.11	5.31	5.13	4.97	5.07	5.19	5.49	5.28	....	....
American-Holderness	5.26	5.09	5.00	5.09	5.09	5.05	4.80	4.68	....	....	....	....	....
Devon	5.15	5.41	5.27	5.28	5.19	....	....	....	....	....	....	....	....
Average	5.21	5.27	5.12	5.07	5.18	5.09	4.86	4.83	4.97	5.05	4.86	4.33	2.59

TABLE 94. AVERAGE ASH IN MILK BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — PER CENT.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	0.55	0.55	0.69	0.74	0.67	0.70	0.63	0.67	0.69	0.67	0.71	0.72	....
Ayrshire	0.67	0 61	0.61	0.58	0.59	0.66	0.63	0.67	0.65	0.62	0.59	0 61	0.66
Jersey	0.74	0.69	0.66	0.65	0.64	0.67	0.68	0.70	0.66	0 69	0.79	....	....
American-Holderness	0.73	0.61	0.61	0.64	0.75	0.65	0.67	0.64	....	....	....	....	....
Devon	0.66	0.63	0.65	0.70	0.71	....	....	....	....	....	....	....	....
Average	0.67	0.62	0.64	0.66	0.65	0.67	0.65	0.67	0.67	0.66	0.70	0.66	0.66

TABLE 95. AVERAGE TOTAL SOLIDS IN MILK BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	78.7	111.9	116.4	103.9	109.8	98.6	83.2	86.9	83.8	78.3	35.9	4.0	....
Ayrshire	75.3	131.8	124.6	103.7	103.5	105.8	95.4	77.2	66.5	43.2	43.6	25.0	3.3
Jersey	63.3	104.7	98.5	87.1	92.5	88.6	82.6	68.1	57.5	39.7	33.2	....	....
American-Holderness	81.1	86.7	79.6	68.3	67.6	55.3	49.5	7.4	....	....	....	....	....
Devon	83.3	106.2	94.9	100.6	86.0	....	....	....	....	....	....	....	....
Average	76.3	108.2	102.8	92.7	91.9	87.1	77.7	59.9	69.3	53.7	37.6	14.5	3.3

TABLE 96. AVERAGE FAT IN MILK BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	22.6	27.4	29.0	24.7	28.4	27.8	25.4	25.6	24.0	21.4	9.7	0.9	....
Ayrshire	22.5	35.1	34.3	29.7	27.4	29.0	28.2	22.4	19.5	13.6	13.3	8.0	0.9
Jersey	21.9	36.3	36.6	31.9	34.1	33.6	32.2	25.9	22.1	14.8	12.7	....	....
American-Holderness....	24.4	26.4	21.7	20.2	19.7	16.5	15.6	2.5	....	....	....	....	....
Devon	27.4	24.0	33.0	34.1	30.4	....	....	....	....	....	....	....	....
Average........	23.8	29.8	30.9	28.1	28.0	26.7	25.3	19.1	21.9	16.6	11.9	4.4	0.9

TABLE 97. AVERAGE CASEIN IN MILK BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian..........	17.8	25.8	27.9	26.5	28.9	26.5	22.2	23.1	20.7	21.5	11.5	1.7	....
Ayrshire..................	17.6	31.1	29.9	27.1	26.2	26.3	24.4	20.6	17.8	11.6	12.1	7.4	1.5
Jersey	15.1	24.8	22.6	20.9	21.6	21.6	20.6	17.2	14.1	9.6	8.7	....	....
American-Holderness	19 6	20.5	20.1	16.3	16.8	14.0	12.6	2.0	....	....	....	....	....
Devon....................	21.4	25.3	22.2	25.1	21.7	....	....	....	....	....	....	....	....
Average	18.3	25.5	24.5	23.2	23.0	22.1	19.9	15.7	17.5	14.2	10.8	4.5	1.5

TABLE 98. AVERAGE SUGAR IN MILK BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	34.4	52.9	52.0	45.8	46.4	38.6	31.8	33.3	34.1	31.5	12.9	1.2	....
Ayrshire..................	31.5	59.0	54.1	42.0	44.8	45.0	38.1	30.1	25.8	16.0	16.0	8.4	0.7
Jersey	23.1	38.7	35.0	30.5	32.9	29.6	26.3	21.9	18.9	13.6	10.3	....	....
American-Holderness	32.4	35.5	33.7	28.3	27.6	21.9	18.8	2.6	....	....	....	....	....
Devon	30.6	42.0	35.3	36.6	29.8	....	....	....	....	....	....	....	....
Average	30.4	45.6	42.0	36.6	36.3	33.8	28.6	21.0	26.3	20.3	13.1	4.8	0.7

TABLE 99. AVERAGE ASH IN MILK BY BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION — POUNDS.

BREED.	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Holstein-Friesian	3.9	5.8	7.5	6.9	6.1	5.7	4.3	4.9	5.0	4.2	1.8	0.2	....
Ayrshire..................	3.7	6.7	6.3	4.9	5.1	5.4	4.7	4.0	3.3	2.0	2.2	1.2	0.2
Jersey	3.2	4.9	4.3	3.8	3.9	3.9	3.6	3.0	2.4	1.7	1.5	....	....
American-Holderness	4.6	4.3	4.0	3.4	3.5	2.8	2.5	0.3	....	....	....	....	....
Devon	3.9	4.9	4.4	4.8	4.1	....	....	....	....	....	....	....	....
Average	3.9	5.3	5.3	4.8	4.5	4.4	3.8	3.0	3.6	2.6	1.8	0.7	0.2

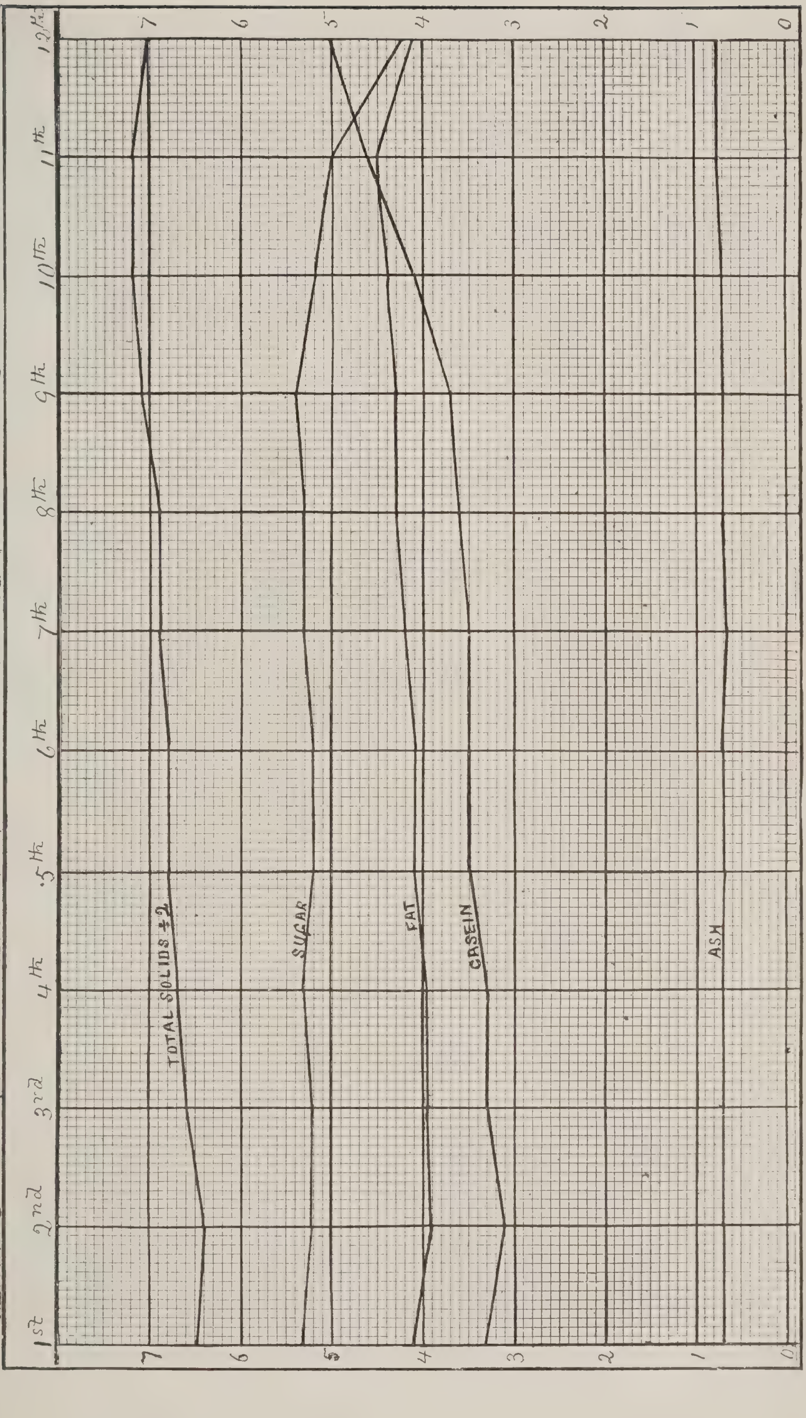
TABLE 100. GENERAL AVERAGES OF ALL BREEDS EACH MONTH OF THIRD PERIOD OF LACTATION.

	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.	Thirteenth.
Milk yield, pounds	586.40	868.70	825.80	723.30	700.60	665.10	586.00	456.80	536.50	404.90	274.40	115.10	25.80
Total solids, per cent	13.27	12.69	12.76	13.01	13.36	13.46	13.32	13.51	13.49	13.98	14.25	13.62	12.69
Fat, per cent	4.19	3.81	3.94	4.01	4 19	4.11	4.39	4.46	4.44	4.60	4.62	3.57	3.40
Casein, per cent	3.20	3.00	3.06	3.26	3.34	3.35	3.43	3.54	3.42	3.66	4.07	5.04	6.04
Sugar, per cent	5.21	5.27	5.12	5.07	5.18	5.09	4.86	4.83	4.97	5.05	4.86	4.33	2.59
Ash, per cent	0.67	0.62	0.68	0.66	0.65	0.67	0.65	0.67	0.67	0.66	0.70	0.66	0.66
Total solids, pounds	76.30	108.20	102.80	92.70	91.90	87.10	77.70	59.90	69.30	53.70	37.60	14.50	3.30
Fat, pounds	23.80	29.80	30.90	28.10	28.00	26.70	25.30	19.10	21.90	16.60	11.90	4.40	0.90
Casein, pounds	18.30	25.50	24.50	23.20	23.00	22.10	19.90	15.70	17.50	14.20	10.80	4.50	1.50
Sugar, pounds	30.40	45.60	42.00	36.60	36.30	33.80	28.60	21.00	26.30	20.30	13.10	4.80	0.70
Ash, pounds	3.90	5.30	5.30	4.80	4.50	4.40	3.80	3.00	3.60	2.60	1.80	0.70	0.20
Crude fat in foods, pounds	22.50	33.80	39.30	40.20	39.80	40.20	31.90	29.90	35.00	34.70	37.90	31.70	16.60
Albuminoids in foods, pounds	47.88	82.17	85.48	81.56	87.27	82.59	66.90	67.53	72.12	65 80	73.25	63.40	32.31
Carbohydrates in foods, pounds	216.90	322.60	373.50	372.30	396.50	401.40	347.80	305.50	321.30	312.70	341.80	285.60	218.20
Starch and sugars in foods, p'nds.	136.00	212.00	234.10	233.40	241.50	243.50	218.60	187.60	206.20	201.70	206.90	157.30	92.00
Crude fiber in foods, pounds	92.70	129.80	151.80	145.10	134.90	138.40	125.30	129.10	147.80	142.50	153.90	139.60	129.10
Ash in foods, pounds	25.80	39.80	40.10	40.40	40.90	38.80	35.70	35.40	38.20	35.90	38.40	41.00	24.30

TABLE 101. GENERAL AVERAGE OF ALL BREEDS FOR EACH MONTH OF FIRST, SECOND AND THIRD PERIODS OF LACTATION.

	First.	Second.	Third.	Fourth.	Fifth.	Sixth.	Seventh.	Eighth.	Ninth.	Tenth.	Eleventh.	Twelfth.
Milk yield, pounds	727.90	739.20	661.70	624.90	591.50	570.50	499.30	500.90	399.10	327.60	243.60	....
Total solids, per cent	13.10	12.90	13.13	13.37	13.59	13.61	13.72	13.74	14.16	14.36	14.45	13.94
Fat, per cent	4.11	3.87	3.96	4.03	4.14	4.12	4.24	4.29	4.27	4.40	4.52	4.11
Casein, per cent	3.28	3.08	3.28	3.31	3.51	3.46	3.51	3.56	3.75	4.05	4.55	5.02
Sugar, per cent	5.35	5.22	5.22	5.30	5.20	5.22	5.25	5.25	5.39	5.19	4.97	4.15
Ash. per cent	0.68	0.69	0.67	0.67	0.70	0.69	0.70	0.69	0.69	0.70	0.73	0.75
Total solids in milk, pounds	93.70	93.70	85.60	82.40	78.70	76.40	67.10	67.50	55.40	46.50	34.80	23.10
Fat in milk, pounds	27.40	28.00	25.30	24.80	23.60	23.30	20.30	20.50	16.60	14.30	10.30	6.80
Casein in milk, pounds	22.00	22.20	21.30	20.40	20.40	19.40	17.10	17.40	14.70	12.80	9.70	6.90
Sugar in milk, pounds	38.90	38.50	34.50	33.10	30.50	29.70	26.00	26.20	21.40	17.10	12.90	8.10
Ash in milk, pounds	4.80	4.90	4.50	4.00	4.10	3.90	3.50	3.50	2.70	2.20	1.80	1.20
Crude fat in foods, pounds	28.00	31.00	33.30	33.00	32.70	30.30	29.30	31.60	31.00	32.50	29.80	19.50
Albuminoids in foods, pounds	62.20	71.00	72.00	75.90	71.90	66.90	68.50	69.30	69.50	71.60	62.20	51.10
Carbohydrates in foods, pounds	280.70	327.90	339.40	351.60	357.50	346.10	317.30	329.00	319.90	316.90	304.90	269.30
Starch and sugars in foods, pounds	183.50	212.60	216.90	220.10	227.90	224.30	202.80	213.00	199.40	209.20	191.10	151.70
Crude fiber in foods, pounds	118.50	130.80	134.10	130.20	131.50	125.50	123.70	135.30	133.40	132.60	127.00	119.50
Ash in foods, pounds	32.40	34.30	36.20	36.50	35.10	34.00	34.10	34.60	34.90	34.60	34.30	26.50

GENERAL AVERAGE OF ALL BREEDS FOR EACH MONTH OF FIRST SECOND AND THIRD PERIODS OF LACTATION. PER CENT.



GENERAL AVERAGE OF ALL BREEDS FOR EACH MONTH OF FIRST SECOND AND THIRD PERIODS OF LACTATION. POUNDS.

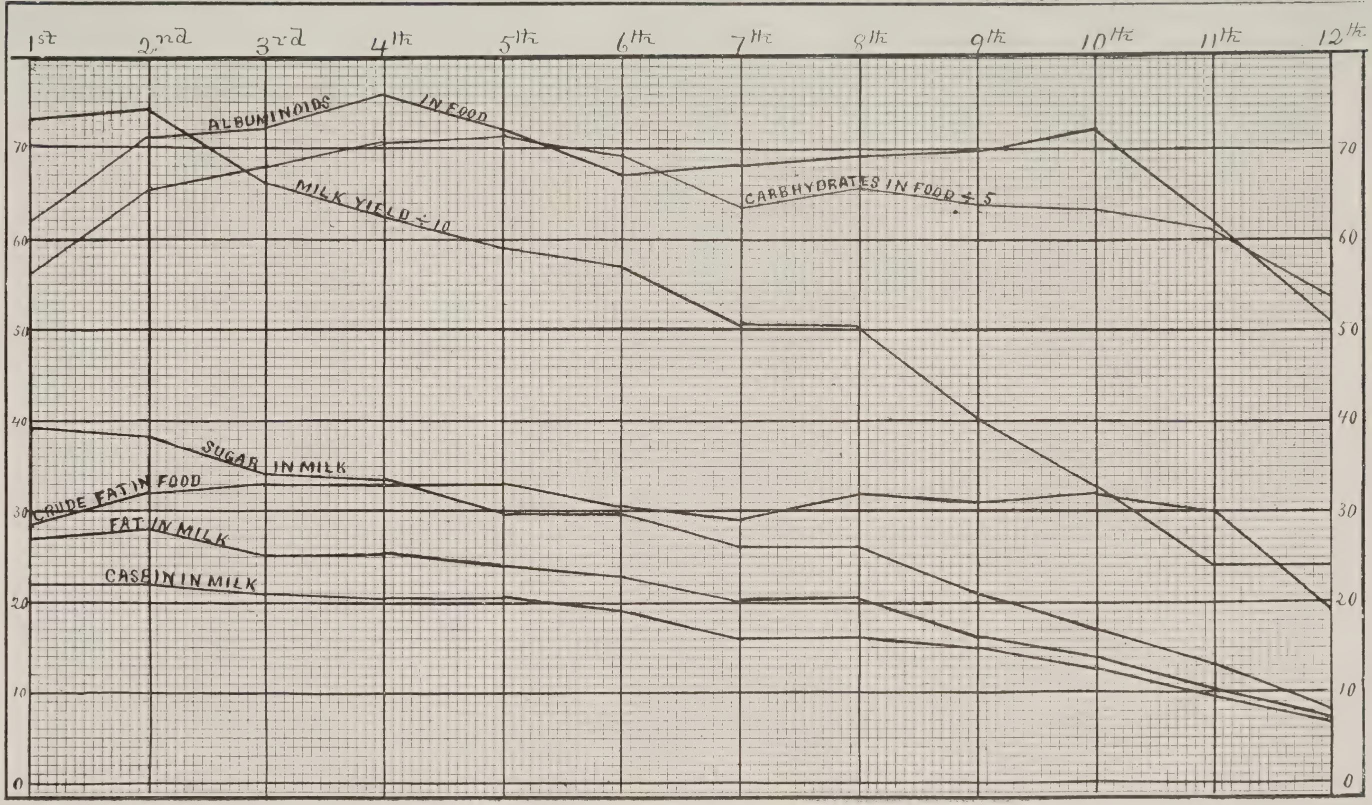


TABLE 102. RELATION OF FAT IN FOOD TO FAT IN MILK, FIRST PERIOD OF LACTATION.

Breed.	NAME OF ANIMAL.	Ether extract in food.	Pure fat in food.	Fat in milk.	Per cent. of pure fat in food to fat in milk.	Pure fat in food between 1st and 2d periods.	No. of months.
		Pounds.	Pounds.	Pounds.			
Holstein-Friesian	Esel 2d	586.6	484.5	435.7	111.2	23.4	19
Holstein-Friesian	Beauty Pledge	593.7	490.4	310.7	157.8	21.3	18
Holstein-Friesian	Netherland Constance*	497.5	410.9	358.7	114.5	....	12⅓
Ayrshire	Queen Dutchess	423.3	349.6	367.9	95.1	15.3	16
Ayrshire	Junietta Peerless	322.3	266.2	179.5	148.2	....	15
Ayrshire	Manton Belle	333.8	275.7	230.4	119.7	2.0	13
Ayrshire	Miss Flow 5th	291.2	240.5	222.8	107.9	4.5	12
Jersey	Gilderbloom	378.9	313.0	293.0	106.8	....	17
Jersey	Countess Flavia	473.8	391.4	477.0	82.1	9.7	19
Jersey	Barbara Allen	402.9	332.8	376.4	88.4	....	16
Jersey	Albert's Carol	519.7	429.3	404.1	106.2	4.7	18
American-Holderness	Nellie 6th	232.2	191.8	145.5	131.8	29.5	13
American-Holderness	Maggie 6th	333.9	275.8	220.1	125.3	54.3	16
Guernsey	Rosette Ford	585.0	483.2	447.0	108.1	62.6	22½
Guernsey	Oriole	624.5	515.8	577.8	89.3	7.8	24
Guernsey	Madam Select	222.1	183.5	208.7	90.1	....	8 2-5
Guernsey	Stella Select	464.8	383.9	320.8	119.7	15.5	14 4-5
Devon	Ione	305.8	252.6	201.9	125.1	8.2	14
Devon	Genevie's Gift	205.2	169.5	173.5	97.7	57.7	12
Devon	Artalia	488.3	403.3	268.1	150.4	26.9	18
Devon	Day Dream B.*	173.7	143.5	111.5	128.7	....	7
Shorthorn	Betsey 10th	555.8	459.1	307.8	149.1	30.7	17
Shorthorn	Lady Spencer*	491.1	405.6	176.3	230.1	....	13
	Totals	9506.1	7851.9	6810.2	....	....	....

*Calculated to December 1, 1893, only. All others complete the period.

TABLE 103. RELATION OF FAT IN FOOD TO FAT IN MILK, SECOND PERIOD OF LACTATION.

Breed.	NAME OF ANIMAL.	Ether extract in food.	Pure fat in food.	Fat in milk.	Per cent. of pure fat in food to fat in milk.	Pure fat in food between 2d and 3d periods.	No. of months.
		Pounds.	Pounds.	Pounds.			
Holstein-Friesian	Esel 2d	541.2	447.0	282.3	158.3	....	13
Holstein-Friesian	Tolsma Artis	888.5	320.9	223.0	143.9	39.6	12 4-5
Ayrshire	Queen Duchess	378.1	312.3	260.8	119.7	15.1	11
Ayrshire	Junietta Peerless	395.4	326.6	234.8	138.7	19.6	11
Ayrshire	Manton Belle	371.2	306.6	229.3	133.7	9.5	10
Ayrshire	Miss Flow 5th	289.2	238.9	185.4	128.9	26.0	12
Jersey	Gilderbloom	357.9	295.6	257.4	114.8	5.9	13
Jersey	Countess Flavia	333.8	275.7	295.6	93.3	3.8	11½
Jersey	Barbara Allen	411.4	339.8	278.1	122.2	2.7	12
American-Holderness	Nellie 6th	260.1	214.8	155.4	138.2	33.8	10½
American-Holderness	Maggie 6th	342.3	282.7	231.3	122.2	20.5	10½
Guernsey	Rosette Ford*	386.3	319.1	350.9	90.9	....	10
Guernsey	Oriole*	402.3	332.3	363.8	91.3	....	12
Guernsey	Madam Select	375.7	310.3	314.0	98.8	....	11½
Guernsey	Stella Select*	241.2	199.2	203.8	97.7	....	6
Devon	Ione	295.9	244.4	178.5	136.9	22.5	9½
Devon	Genevie's Gift	262.0	216.4	214.9	100.7	....	10
Devon	Artalia*	181.7	150.1	103.9	144.5	....	5
	Totals	6214.2	5132.7	4363.2	....	....	....

* Calculated to December 1, 1893, only. All others complete the period.

TABLE 104. RELATION OF FAT IN FOOD TO FAT IN MILK, THIRD PERIOD OF LACTATION.

Breed.	NAME OF ANIMAL.	Ether extract in food.	Pure fat in food.	Fat in milk.	Per cent. of pure fat in food to fat in milk.	Pure fat in food between 3d and 4th periods.	No. of months.
		Pounds.	Pounds.	Pounds.			
Holstein-Friesian	Tolsma Artis	485.2	400.8	266.9	150.2	....	12
Ayrshire	Miss Flow 5th	382.5	315.9	222.6	141.9	20.0	10
Ayrshire	Manton Belle	468.3	386.8	312.9	123.6	....	12
Ayrshire	Junietta Peerless*	270.9	223.8	218.2	102.6	....	7
Jersey	Gilderbloom*	251.2	207.5	243.5	85.2	....	7½
Jersey	Countess Flavia	328.1	271.0	289.8	93.5	12.7	10⅔
Jersey	Barbara Allen*	259.4	214.3	248.4	86.3	....	7
American-Holderness	Maggie 6th*	240.4	198.6	191.9	103.5	....	6½
American-Holderness	Nellie 6th	200.0	165.2	115.8	142.6	....	9
Devon	Ione†	185.1	152.9	162.0	94.4	....	5½
	Totals	3071.1	2536.8	2272.0	....	....	....

* Calculated to December 1, 1893, only. All others, except Ione, complete the period.

† Calculated to November 14, 1893, only.

TABLE 105. COST OF PRODUCTION OF MILK AND FAT.—FIRST PERIOD OF LACTATION.

Breed.	NAME OF ANIMAL.	Total cost.	Number of days.	Average cost per day.	Total milk yield.	Total fat yield.	Average cost of milk per pound.	Average cost of fat per pound.
				Cents.	Pounds.	Pounds.	Cents.	Cents.
Holstein-Friesian	Esel 2d	$127 53	761	16.76	13787.0	435.1	.925	29.3
Holstein-Friesian	Beauty Pledge	86 75	581	14.93	9361.2	310.7	.927	27.9
Holstein-Friesian	Netherland Constance*	73 43	383	19.17	12104.3	358.7	.607	20.5
	Average	....	....	16.95	....	....	.820	25.9
Ayrshire	Miss Flow 5th	$55 81	361	15.46	5251.2	222.8	1.052	24.8
Ayrshire	Queen Duchess	71 97	485	14.94	9490.1	367.9	.758	19.6
Ayrshire	Manton Belle	52 68	379	13.90	6796.8	230.4	.775	22.9
Ayrshire	Junietta Peerless	53 57	451	11.88	5753.3	179.5	.931	29.8
	Average	....	....	14.05	....	....	.879	24.3
Jersey	Gilderbloom	$69 64	528	13.19	5319.1	293.0	1.309	23.8
Jersey	Countess Flavia	82 69	529	14.79	8035.5	477.0	1.029	17.3
Jersey	Barbara Allen	83 01	610	13.61	7959.9	436.7	1.043	19.0
Jersey	Albert's Carol	73 05	537	13.60	7071.1	404.1	1.033	18.1
	Average	....	....	13.80	....	....	1.103	19.5
American-Holderness	Nellie 6th	$38 72	372	10.41	4178.5	145.5	.927	26.6
American-Holderness	Maggie 6th	57 41	462	12.43	6182.2	220.1	.928	26.1
	Average	....	....	11.42	....	....	.928	26.3
Guernsey	Rosette Ford	$89 75	670	13.40	8143.2	447.0	1.102	20.1
Guernsey	Oriole	94 12	724	13.00	10877.3	577.8	.865	16.3
Guernsey	Madame Select	28 18	237	11.90	2849.3	203.7	.989	13.8
Guernsey	Stella Select	62 42	456	13.70	6580.5	320.8	.949	19.5
	Average	....	....	13.00	....	....	.976	17.4

Devon	Ione	$53 73	451	11.91	6636.6	201.9	.869	26.6
Devon	Genevie's Gift	40 07	443	9.05	3976.6	206 5	1.008	19.4
Devon	Artalia	68 76	492	13.98	6202.6	268.1	.991	25.6
Devon	Day Dream B.*	21 40	219	9.77	2195.4	111.5	.975	19.2
	Average	....	....	11.18	....	....	.946	22.7
Shorthorn	Betsey 10th	$75 73	514	14.73	6939.0	307.8	1.077	24.6
Shorthorn	Lady Spencer*	67 68	406	16 67	4346.7	176.3	1.557	38.4
	Average	....	....	15.70	....	....	1.317	31.5
	Average of individuals	....	....	13.62	....	....	.981	23.0
	Average of breeds	....	....	13.73	....	....	.996	23.9

* Calculated to December 1, 1893, only. All others complete the period.

TABLE 106. COST OF PRODUCTION OF MILK AND FAT — SECOND PERIOD OF LACTATION.

Breed.	NAME OF ANIMAL.	Total cost.	Number of days.	Average cost per day.	Total milk yield.	Total fat yield.	Average cost of milk per pound.	Average cost of fat per pound.
				Cents.	Pounds.	Pounds.	Cents.	Cents.
Holstein-Friesian	Esel 2d	$75 83	396	19.15	7788.0	282.3	.974	26.9
Holstein-Friesian	Tolsma Artis	65 17	388	16.80	8076.1	223.0	.807	29.2
	Average	....	....	17.97	....	....	.890	28.0
Ayrshire	Miss Flow 5th	$48 53	365	13.30	5319.3	185.4	.912	26.2
Ayrshire	Queen Duchess	54 48	335	16.26	7169 3	260.8	.760	20.9
Ayrshire	Manton Belle	50 80	304	16 71	6258.0	229.3	.812	22.2
Ayrshire	Junietta Peerless	55 16	333	16.56	7347.1	234.8	.751	23.5
	Average	....	....	15.71	....	....	.806	23 2
Jersey	Gilderbloom	$48 08	396	12.14	4793.5	257.5	1.003	18.7
Jersey	Countess Flavia	49 34	350	14.10	5207.7	295.6	.947	16.7
Jersey	Barbara Allen	53 60	365	14 68	5434.0	278.1	.986	19.3
	Average	....	....	13.64	....	....	.979	18.2
American-Holderness	Maggie 6th	$48 57	318	15.77	6124.7	231.3	.793	21.0
American-Holderness	Nellie 6th	41 95	323	12.99	4632.3	155.4	.905	27.0
	Average	....	....	14.13	....	....	.849	24.0
Guernsey	Rosette Ford*	$54 98	304	18.09	6130.4	350.9	.897	15.7
Guernsey	Oriole*	55 73	357	15.61	6659 9	363.8	.837	15 3
Guernsey	Madam Select	52 77	352	15.00	5053.0	314 0	1.044	16 8
Guernsey	Stella Select*	31 18	183	17.04	4312.7	203.8	.723	15.3
	Average	....	....	16.43	....	....	.875	15.8
Devon	Ione	$41 48	288	14 40	3954 3	178.5	1.049	23.2
Devon	Genevie's Gift	38 64	300	12.88	4016 7	214.9	.962	18.2
Devon	Artalia*	23 14	157	14.74	2446 2	103.9	.946	22.3
	Average	....	....	14.01	....	....	.986	21.2
	Average of individuals	....	....	15 32	....	....	.895	21.0
	Average of breeds	....	....	15.31	....	....	.897	21.7

* Calculated to December 1, 1893, only. All others complete the period.

TABLE 107. Cost of Production of Milk and Fat — Third Period of Lactation.

Breed.	NAME OF ANIMAL.	Total cost.	Number of days.	Average cost per day.	Total milk yield.	Total fat yield.	Average cost of milk per pound.	Average cost of fat per pound.
				Cents.	Pounds.	Pounds.	Cents	Cents.
Holstein-Friesian	Tolsma Artis	$64 42	358	17.99	8560.9	266.9	.758	24.1
Ayrshire	Miss Flow 5th	$51 82	315	16.45	6330.2	222.6	.818	23.3
Ayrshire	Manton Belle	65 24	358	18.22	8648.4	312.9	.754	20.8
Ayrshire	Junietta Peerless*	35 98	209	17.21	6620.8	218.2	.543	16.5
	Average	....	....	17.29	....	....	.705	20.2
Jersey	Gilderbloom*	$34 06	231	14.74	4557.0	243.5	.747	14.0
Jersey	Countess Flavia	47 94	332	14.44	4720.3	289.8	1.016	16.5
Jersey	Barbara Allen*	34 94	210	16.64	4787.3	348.4	.730	14.1
	Average	....	....	15.27	....	....	.831	14.9
American-Holderness	Maggie 6th*	$33 03	201	16.43	5036.2	191 9	.636	17.2
American-Holderness	Nellie 6th	30 58	271	11.28	3209.8	115.8	.607	26.4
	Average	....	....	13.85	....	......	.621	21.8
Devon	Ione†	$23 20	167	13.89	3520.2	162.0	.658	14.3
	Average of individuals	....	....	15.73	....	....	.726	18.7
	Average of breeds	....	....	15.66	....	....	.713	19.1

* Calculated to December 1, 1893, only. All others, except Ione, complete period. † Calculated to November 14, 1893, only.

TABLE 108. RELATIVE COST OF PRODUCTION OF MILK AND FAT — FIRST PERIOD OF LACTATION.

MILK.	Ratio.	FAT.	Ratio.
Netherland Constance	100	Madam Select	100
Queen Duchess	125	Oriole	118
Manton Belle	128	Countess Flavia	125
Ione	133	Albert's Carol	131
Oriole	142	Barbara Allen	138
Esel 2d	152	Day Dream B	139
Beauty Pledge	153	Genevie's Gift	141
Nellie 6th	153	Stella Select	141
Maggie 6th	153	Queen Duchess	142
Junietta Peerless	153	Rosette Ford	146
Stella Select	156	Netherland Constance	148
Day Dream B	161	Manton Belle	166
Madam Select	163	Gilderbloom	172
Artalia	163	Betsey 10th	178
Genevie's Gift	166	Miss Flow 5th	180
Countess Flavia	170	Artalia	185
Albert's Carol	170	Maggie 6th	189
Barbara Allen	172	Nellie 6th	193
Miss Flow 5th	173	Ione	193
Betsey 10th	177	Beauty Pledge	202
Rosette Ford	182	Esel 2d	212
Gilderbloom	216	Junietta Peerless	216
Lady Spencer	256	Lady Spencer	278

Relative Cost by Breeds.

MILK.	Ratio.	FAT.	Ratio.
Holstein-Friesian	100	Guernsey	100
Ayrshire	107	Jersey	112
American-Holderness	113	Devon	130
Devon	115	Ayrshire	140
Guernsey	119	Holstein Friesian	149
Jersey	135	American-Holderness	151
Shorthorn	161	Shorthorn	181

TABLE 109. Relative Cost of Production of Milk and Fat—Second Period of Lactation.

MILK.	Ratio.	FAT.	Ratio.
Stella Select	100	Oriole	100
Junietta Peerless	104	Stella Select	100
Queen Duchess	105	Rosette Ford	103
Maggie 6th	110	Countess Flavia	109
Tolsma Artis	112	Madam Select	109
Manton Belle	112	Genevie's Gift	119
Oriole	116	Gilderbloom	122
Rosette Ford	124	Barbara Allen	126
Nellie 6th	125	Queen Duchess	137
Miss Flow 5th	126	Maggie 6th	137
Artalia	131	Manton Belle	145
Countess Flavia	131	Artalia	146
Genevie's Gift	133	Ione	152
Esel 2d	135	Junietta Peerless	154
Barbara Allen	136	Miss Flow 5th	171
Gilderbloom	139	Esel 2d	176
Madam Select	144	Nellie 6th	176
Ione	145	Tolsma Artis	191
Relative Cost by Breeds.			
Ayrshire	100	Guernsey	100
American-Holderness	105	Jersey	115
Guernsey	109	Devon	134
Holstein-Friesian	110	Ayrshire	147
Jersey	121	American-Holderness	152
Devon	122	Holstein-Friesian	177

TABLE 110. RELATIVE COST OF PRODUCTION OF MILK AND FAT — THIRD PERIOD OF LACTATION.

MILK.	Ratio.	FAT.	Ratio.
Junietta Peerless	100	Gilderbloom	100
Nellie 6th	112	Barbara Allen	101
Maggie 6th	117	Ione	102
Ione	121	Countess Flavia	118
Barbara Allen	134	Junietta Peerless	118
Gilderbloom	138	Maggie 6th	123
Tolma Artis	138	Manton Belle	148
Manton Belle	139	Miss Flow 5th	166
Miss Flow 5th	151	Tolsma Artis	172
Countess Flavia	187	Nellie 6th	189
Relative Cost by Breeds.			
American-Holderness	100	Devon	100
Devon	106	Jersey	104
Ayrshire	113	Ayrshire	141
Holstein-Friesian	121	American-Holderness	152
Jersey	134	Holstein-Friesian	168

TABLE 111. COST OF MILK AND FAT PER POUND.

Number of periods.	MILK.	Cost, cents.	Ratio.
1	Netherland Constance	.607	100
3	Junietta Peerless	.742	122
2	Queen Duchess	.759	125
2	Tolsma Artis	.779	128
3	Manton Belle	.780	128
3	Maggie 6th	.786	129
3	Nellie 6th	.813	134
2	Stella Select	.836	138
3	Ione	.839	138
2	Oriole	.851	140
3	Barbara Allen	.920	151
3	Miss Flow 5th	.927	153
1	Beauty Pledge	.927	153
2	Esel 2d	.949	156
2	Artalia	.968	160
1	Day Dream B	.975	161
2	Genevie's Gift	.985	162
3	Countess Flavia	.997	164
2	Rosette Ford	.999	164
2	Madam Select	1.016	167
3	Gilderbloom	1.019	168
1	Albert's Carol	1.033	170
1	Betsey 10th	1.077	177
1	Lady Spencer	1.557	256
	Average	.9225	
	American-Holderness	.800	100
	Ayrshire	.802	100
	Holstein-Friesian	.816	102
	Guernsey	.926	116
	Devon	.942	118
	Jersey	.992	124
	Shorthorn	1.317	165
	Average	.942	

TABLE 111. COST OF MILK AND FAT PER POUND — (*Concluded*).

Number of periods.	FAT.	Cost, cents.	Ratio.
2	Madam Select	15.3	100
2	Oriole	15.8	103
3	Countess Flavia	16.8	110
2	Stella Select	17.4	114
3	Barbara Allen	17.5	114
2	Rosette Ford	17.9	117
1	Albert's Carol	18.1	118
3	Gilderbloom	18.8	123
2	Genevie's Gift	18.8	123
1	Day Dream B	19.2	125
2	Queen Duchess	20.2	132
1	Netherland Constance	20.5	134
3	Maggie 6th	21.4	140
3	Ione	21.4	140
3	Manton Belle	22.0	144
3	Junietta Peerless	23.3	152
2	Artalia	23.9	156
1	Betsey 10th	24.6	161
3	Miss Flow 5th	24.8	162
2	Tolsma Artis	26.6	174
3	Nellie 6th	26.7	174
1	Beauty Pledge	27.9	182
2	Esel 2d	28.1	184
1	Lady Spencer	38.4	251
	Average	21.9	
	Guernsey	16.6	100
	Jersey	17.8	107
	Devon	20.8	125
	Ayrshire	22.6	136
	American-Holderness	24.1	145
	Holstein-Friesian	25.8	155
	Shorthorn	31.5	190
	Average	22.7	

TABLE 112. GENERAL RESULTS — FIRST PERIOD OF LACTATION.

Breed.	NAME OF ANIMAL.	Weight after calving at beginning of 1st period.	Total abuminoids in food.	Total carbohydrates in food.	Total crude fat in food.	Total fat in milk.	Weight after calving at end of 1st period.
Holstein-Friesian	Esel 2d	958	1758.0	9434.5	614.9	435.7	1195
Holstein-Friesian	Beauty Pledge	873	1373.2	6725.8	619.5	310.7	....
Holstein-Friesian	Netherland Constance†	989	1113.9	5106.3	497.5	358.7	....
Ayrshire	Queen Duchess	778	1043.3	5079.9	441.8	367.9	892
Ayrshire	Juniette Peerless	743	800.2	4017.8	322.3	179.5	877
Ayrshire	Manton Belle	976	804.4	3989.0	336.2	230.4	1105
Ayrshire	Miss Flow 5th	736	694.7	3531.7	296.6	222.8	809
Jersey	Gilderbloom	770	975.5	4855.4	378.9	293.0	907
Jersey	Countess Flavia	695	1133.0	5371.6	485.5	477.0	794
Jersey	Barbara Allen	831	980.6	4848.1	402.9	376.4	891
Jersey	Albert's Carol*	619	1142.9	5183.1	525.4	404.1	754
American Holderness	Nellie 6th	756	601.9	2987.9	267.9	145.5	841
American-Holderness	Maggie 6th	777	952.9	4996.8	399.6	220.1	917
Guernsey	Rosette Ford	851	1452.5	7515.9	660.8	447.0	945
Guernsey	Oriole	686	1428.5	7142.9	633.9	577.8	775
Guernsey	Mada Select*	735	428.9	2129.1	222.1	203.7	753
Guernsey	Stella Select*	758	938.6	4608.8	483.6	320.8	868
Devon	Ione	713	808.1	4066.8	315.7	201.9	919
Devon	Genevie's Gift	550	732.4	3803.4	275.1	173.5	756
Devon	Artalia	914	1078.1	5441.0	520.9	268.1	994
Devon	Day Dream B.†	988	342.9	1653.9	173.7	111.5	....
Shorthorn	Betsey 10th	1020	1254.3	5837.7	593.0	307.8	1066
Shorthorn	Lady Spencer †	1120	1072.4	5060.6	491.1	176.3	....
	Average	782	996.1	4929.9	433.0	296.1	898

* Weight upon arrival at station. † Calculated to December 1, 1893, only. All others complete period.

TABLE 113.

GENERAL RESULTS — SECOND PERIOD OF LACTATION.

Breed.	NAME OF ANIMAL.	Weight after calving at beginning of 2d period.	Total albuminoids in food.	Total carbohydrates in food.	Total crude fat in food.	Total fat in milk.	Weight after calving at end of 2d period.
Holstein Friesian	Esel 2d	1195	1169.0	5408.1	541.2	282.3	....
Holstein-Friesian	Tolsma Artis	1045	1033.7	5430.8	436.4	223 0	1094
Ayrshire	Queen Duchess	892	823.9	4444.8	396.3	260.8	....
Ayrshire	Junietta Peerless	877	851.1	4188.4	419.1	234.8	882
Ayrshire	Manton Belle	1105	778.6	4045.2	382.7	229.3	1084
Ayrshire	Miss Flow 5th	809	802.0	4118.1	320.6	185.4	917
Jersey	Gilderbloom	907	736.5	3774.5	365.0	257.4	867
Jersey	Countess Flavia	794	775.8	3851.1	338.4	295.6	778
Jersey	Barbara Allen	891	864.3	4181.4	414.6	278.1	875
American-Holderness	Nellie 6th	841	698.4	3255.5	301.0	155.4	848
American-Holderness	Maggie 6th	917	803.4	3654.3	367.1	231 3	853
Guernsey	Rosette Ford*	945	825.6	3816.7	386.3	350.9	....
Guernsey	Oriole*	775	849.2	4000.8	402.3	363.8	....
Guernsey	Madame Select	753	840.8	3911.5	375.7	314.0	....
Guernsey	Stella Select*	868	491.8	2256.2	241.2	203.8	....
Devon	Ione	919	711.8	3239.7	323.1	178.5	926
Devon	Genevie's Gift	756	648.6	2910.6	262.0	214.9	....
Devon	Artalia*	994	358.6	1716.0	181.7	103.9	....
	Average	910	781.3	3789.1	358.6	242.4	912

* Calculated to December 1, 1893, only. All others complete period.

TABLE 114. GENERAL RESULTS — THIRD PERIOD OF LACTATION.

Breed.	NAME OF ANIMAL.	Weight after calving at beginning of 3d period.	Total abuminoids in food.	Total carbohydrates in food.	Total crude fat in food.	Total fat in milk.	Weight after calving at end of 3d period.
Holstein-Friesian	Tolsma Artis	1094	1103.3	5188.8	529.0	266.9	1200
Ayrshire	Miss Flow	917	850.2	4104.2	406.7	222.6	937
Ayrshire	Manton Belle	1084	1038.7	4775.0	468.3	312.9	....
Ayrshire	Junietta Peerless*	882	557.4	2568.6	270.9	218.2	....
Jersey	Gilderbloom*	867	501.2	2389.8	251.2	243.5	....
Jersey	Countess Flavia	778	783.2	3535.1	343.5	289.8	783
Jersey	Barbara Allen*	875	527.5	2476.6	259.4	248.4	....
American-Holderness	Maggie 6th*	853	497.1	2235.4	240.4	191.9	....
American-Holderness	Nellie 6th	848	499.3	2001.8	212.0	115.8	....
Devon	Ione†	926	375.7	1689.4	185.1	162.0	....
	Average	930	673.4	3096.5	316.6	227.2	973

* Calculated to December 1, 1893, only. All others, except Ione, complete period.

† Calculated to November 14, 1893, only.

TABLE 115. AVERAGE FOOD FED EACH ANIMAL FROM JANUARY, 1890, TO DECEMBER, 1893.

	Pounds hay.	Pounds ensilage.	Pounds green forage.	Pounds roots.	Pounds mixed grain.	Kinds of mixed grain.
February, 1890	183.6	....	....	38.0	82.5	No. 6.
March	326.0	230.0	....	....	186.0	No. 6.
April	238.0	....	....	319.5	180.0	No. 6.
May and June	402.4	604.4	....	....	249.9	No. 6.
July	241.7	....	435.1	....	276.2	No. 6.
August and September	130.5	628.2	280.9	....	210.3	
October	247.7	....	361.1	200.4	216.5	No. 11.
November	290.8	....	....	511.5	218.3	No. 11.
December and January, 1891	247.7	652.8	....	....	210.3	No. 13.
February and March	184.7	763.7	....	....	207.8	No. 14.
April and May	251.4	566.0	....	....	196.8	No. 16.
June and July	152.2	319.6	658.7	....	201.6	No. 17.
August	....	850.3	494.4	....	204.6	No. 19.
September	182.8	....	868.1	....	192.8	No. 19.
October	340.9	....	509.0	....	207.5	No. 21.
November	264.4	594.7	....	....	198.8	No. 21.
December and January, 1892	249.7	611.0	....	....	200.2	No. 23.
February and March	244.9	687.2	....	....	181.6	No. 24.
April and May	285.6	483.0	....	....	173.1	No. 25.
June and July	162.6	....	1371.3	....	183.6	No. 26.
August and September	161.9	....	1409.0	....	198.7	No. 27.
October and November	174.5	885.4	....	667.0	179.2	No. 28.
December	183.1	691.5	....	747.1	263.7	No. 29.
January, 1893	320.6	705.5	....	....	238.6	No. 29.

February and March	314.4	628.2	....	....	199.3	No. 30.
April and May	192.4	1078.4	....	....	223.9	No. 31.
June and July	158.4	....	1422.9	....	190.7	No. 32.
August first to August fifteenth, inclusive	209.8	....	48.4	....	94.9	No. 33.
August sixteenth to August thirty-first, inclusive	181.1	....	416.8	....	108.0	No. 34.
September	163.0	....	1530.4	....	188.7	No. 34.
October	170.4	....	1024.9	593.1	198.5	No. 35.
November	167.4	1327.9	....	....	195.1	No. 35.

TABLE 116. PERCENTAGE VARIATION BY MONTHS IN FOOD AND MILK CONSTITUENTS.

MONTHS.	Milk yield.	Per cent. fat in milk.	Per cent. casein in milk.	Pounds fat in milk.	Pounds casein in milk.	Pounds fat in food.	Pounds albuminoids in food.	Pounds carbo-hydrates in food.	Weight of animals.
1890.									
October	100	100	100	100	100	100	100	100	100
November	95	101	109	95	102	100	107	102	98
December	95	106	107	99	101	106	111	106	98
1891.									
January	98	99	93	96	91	97	94	116	99
February	87	96	103	81	88	104	108	110	98
March	91	98	114	88	103	111	118	108	97
April	86	95	108	82	93	118	131	99	98
May	91	93	116	84	105	124	123	97	100
June	95	89	109	83	102	145	136	101	101
July	96	88	113	82	107	129	132	103	103
August	88	97	116	79	101	117	128	115	102
September	77	96	116	73	89	102	163	113	109
October	79	96	136	74	106	97	145	139	110
November	76	105	120	76	90	94	138	136	115
December	88	99	109	85	88	96	126	122	112
1892.									
January	95	107	100	102	94	98	134	125	111
February	100	101	116	80	89	70	107	103	110
March	100	101	109	106	114	107	126	127	108
April	90	106	110	103	104	115	92	110	104

May	101	96	101	106	112	121	92	116	106
June	106	91	102	103	116	145	135	106	106
July	109	82	98	93	112	176	138	135	106
August	96	92	106	88	103	178	179	129	108
September	103	85	104	83	103	158	180	122	110
October	106	93	108	93	110	183	146	160	112
November	110	95	110	99	117	148	144	141	116
December	126	95	112	113	136	146	197	156	116
1893.									
January	121	105	111	121	129	157	189	146	118
February	102	110	111	101	110	129	156	118	120
March	113	106	109	86	121	144	176	132	119
April	114	105	106	117	118	166	145	142	125
May	114	109	107	122	120	131	113	112	115
June	118	104	101	119	117	135	151	107	112
July	124	97	103	114	125	144	169	117	111
August	116	98	99	113	113	180	160	119	112
September	120	99	106	117	125	200	170	153	114
October	107	109	113	111	120	167	147	146	114
November	92	115	114	104	103	106	101	119	111

TABLE 117. NUMBER OF DAYS AND DAILY MILK YIELD IN SUCCESSIVE PERIODS OF LACTATION.

Breed.	NAME OF ANIMAL.	FIRST PERIOD.		SECOND PERIOD.		THIRD PERIOD.		FOURTH PERIOD.	
		Number of days.	Average yield, pounds.	Number of days.	Average yield, pounds.	Number of days.	Average yield, pounds.	Number of days.	Average yield, pounds.
Ayrshire	Miss Flow 5th	377	14.71	365	14.57	309	20.48	253	23.46
Ayrshire	Manton Belle	373	18.22	283	22.02	341	25.27		
Ayrshire	Junietta Peerless	431	13.25	330	22.96	236	31.82		
Ayrshire	Queen Duchess	460	20.61	315	22.72				
	Average		16.70		20.57		25.86		23.46
Guernsey	Rosette Ford	704	11.56	334	19.71				
Guernsey	Oriole	723	15.03	385	18.08				
Guernsey	Stella Select	413	15.78	224	22.48				
Guernsey	Madam Select	236	12.32	349	14.42				
	Average		13.67		18.67				
Jersey	Gilderbloom	534	9.96	392	12.22	259	19.51		
Jersey	Countess Flavia	540	14.85	357	14.53	319	14.77		
Jersey	Barbara Allen	566	13.58	381	14.16	237	22.68		
Jersey	Albert's Carol	534	13.23	58	16.56				
	Average		12.91		14.37		18.99		
American-Holderness	Nellie 6th	360	11.60	316	14.66	254	12.62		
American-Holderness	Maggie 6th	460	13.44	311	19.30	230	24.42		
	Average		12.52		16.98		18.51		
Holstein-Friesian	Esel 2d	733	18.80	396	19.65				
Holstein-Friesian	Tolsma Artis	288	18.79	381	21.19	345	24.81		
Holstein-Friesian	Netherland Constance	441	29.25						
Holstein-Friesian	Beauty Pledge	569	16.42						
	Average		20.82		20.42		24.81		
Devon	Ione	416	11.28	274	14.40	179	19.62		
Devon	Genevie's Gift	427	9.31	305	13.16				
Devon	Day Dream B	245	10.03						
Devon	Artalia	489	12.67	185	15.31				
	Average		10.82		14.29		19.62		

Shorthorn	Betsey 10th......................	511	13.58	34	28.05	....	....	....	....
Shorthorn	Lady Spencer	432	10.36	....	....	....	....	....	....
		....	11.97	....	28.05	....	....	....	....
	Breed, general average......	....	14.20	....	19.05	....	21.56	....	23.46
	Animals, general average...	....	14.61	....	18.01	....	21.60	....	23.46

TABLE 118. NUMBER OF DAYS AND MILK YIELD IN DIFFERENT PERIODS OF LACTATION — MORNING AND EVENING.

Breed.	NAME OF ANIMAL.	FIRST PERIOD.			SECOND PERIOD.			THIRD PERIOD.			FOURTH PERIOD.		
		Number of days.	Yield of A. M.	Yield of P. M.	Number of days.	Yield of A. M.	Yield of P. M.	Number of days.	Yield of A. M.	Yield of P. M.	Number of days.	Yield of A. M.	Yield of P. M.
Ayrshire	Miss Flow 5th	357	2704.8	2546.4	365	2761.5	2557.8	309	3234.7	3094.3	253	3027.0	2909.2
Ayrshire	Manton Belle	373	3461.0	3333.8	283	3168.9	3061.7	341	4450.4	4166.5	......	....	....
Ayrshire	Junietta Peerless	431	2850.7	2861.9	330	3739.3	3607.8	236	3793.0	3715.9	......	....	....
Ayrshire	Queen Duchess	460	4688.0	4793.2	315	3609.8	3545.9	......	....	....	......	....	....
	Total	1,621	13704.5	13535.3	1,293	13279.5	12773.2	886	11478.1	10976.7	253	3027.0	2909.2
Guernsey	Rosette Ford	704	4030.3	4110.9	334	3337.7	3244.9	......	....	....	......	....	....
Guernsey	Oriole	723	5455.2	5408.6	385	3533.9	3427.0	......	....	....	......	....	....
Guernsey	Stella Select	413	3255.8	3262.8	224	2393.2	2419.1	......	....	....	......	....	....
Guernsey	Madam Select	236	1414.2	1425.3	349	2492.4	2541.9	......	....	....	......	....	....
	Total	2,076	14155.5	14207.6	1,292	11757.2	11632.9	......	....	....	......	....	....
Jersey	Gilderbloom	534	2745.8	2573.3	392	2464.1	2325.9	259	2542.5	2509.8	......	....	....
Jersey	Countess Flavia	540	4063.4	3953.7	357	2617.6	2567.4	319	2349.9	2361.4	......	....	....
Jersey	Barbara Allen	586	4009.2	3947.8	381	2709.1	2686.3	237	2701.2	2673.6	......	....	....
Jersey	Albert's Carol	534	3585.0	3477.0	58	485.6	474.8	......	....	....	......	....	....
	Total	2,194	14403.4	13951.8	1,188	8276.4	8054.4	815	7593.6	7544.8	......	....	....
American-Holderness	Nellie 6th	360	2095.6	2080.2	316	2348.1	2283.7	254	1582.5	1623.5	......	....	....
American-Holderness	Maggie 6th	460	3101.7	3080.6	311	3066.2	2937.1	230	2808.6	2808.2	......	....	....
	Total	820	5197.3	5160.8	627	5414.3	5220.8	484	4391.1	4431.7	......	....	....
Holstein-Treisian	Esel 2d	733	6985.5	6792.8	396	3966.6	3814.2	......	....	....	......	....	....
Holstein-Freisian	Tolsma Artis	288	2781.8	2629.5	381	4059.8	4015.4	345	4328.7	4230.1	......	....	....
Holstein-Freisian	Netherl'nd Constance	441	6490.5	6309.8	......	....	....	......	....	....	......	....	....
Holstein-Freisian	Beauty Pledge	569	4791.9	4552.5	......	....	....	......	....	....	......	....	....
	Total	2,031	21049.7	20284.6	777	8026.4	7829.6	345	4328.7	4230.1	......	....	....

Devon	Ione	416	2351.9	2271.3	274	2039.0	1907.3	179	1786.0	1726.2	......	....	....
Devon	Genevie's Gift	427	2010.8	1965.5	305	2030.3	1982.7	......	....	....	......	....	....
Devon	Day Dream B.	245	1244.3	1214.2	......	....	....	......	....	....	......	....	....
Devon	Artalia	489	3140.2	3054.8	185	1423.2	1408.4	......	....	....	......	....	....
	Total	1,577	8747.2	8505.8	764	5492.5	5298.4	179	1786.0	1726.2	......	....	....
Shorthorn	Betsey 10th	511	3574.2	3364.8	34	484.8	468.8	......	....	....	......	....	....
Shorthorn	Lady Spencer	432	2274.3	2203.6	......	....	....	......	....	....	......	....	....
	Total	943	5848.5	5568.4	34	484.8	468.8	......	....	....	......	....	....
	Grand total	11,262	83106.1	81204.3	5,975	52731.1	51278.1	2,709	29577.5	28909.5	253	3027.0	2909.2
	Ratio	......	100	97.7	......	100	97.3	......	100	97.7	......	100	96.1

TABLE 119. RELATIVE SIZE AND NUMBER OF MILK GLOBULES PER 1000 IN SUCCESSIVE PERIODS OF LACTATION.

BREED.	FIRST PERIOD.						SECOND PERIOD.						THIRD PERIOD.						FOURTH PERIOD.					
	0–1.	1–2.	2–3.	3–4.	4–5.	5–6.	0–1.	1–2.	2–3.	3–4.	4–5.	5–6.	0–1.	1–2.	2–3.	3–4.	4–5.	5–6.	0–1.	1–2.	2–3.	3–4.	4–5.	5–6.
Jerseys	104	437	280	128	43	8	369	303	206	87	28	7	336	326	150	112	27	9	577	209	107	60	41	4
Ayrshires	142	540	243	60	13	2	423	388	151	30	7	1	449	370	136	38	6	1	458	383	125	28	6	0
American-Holderness	113	524	291	62	9	1	398	384	176	38	4	0	399	406	151	38	6	0	.....	.....	.....	.....	.....	.....
Devons	224	460	237	66	12	1	331	400	207	51	9	1	292	425	212	60	11	0	.....	.....	.....	.....	.....	.....
Holstein-Friesian	236	502	208	45	8	1	379	426	160	32	3	0	439	409	130	20	2	0	.....	.....	.....	.....	.....	.....
Guernseys	173	368	301	120	33	5	389	311	200	79	19	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Shorthorns	347	340	201	79	29	4	410	217	150	134	63	26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Average	191	453	252	80	21	3	386	347	179	64	19	5	383	387	156	54	11	2	518	296	116	44	24	2

TABLE 120. PER CENT OF TOTAL FAT IN DIFFERENT SIZED GLOBULES IN SUCCESSIVE PERIODS OF LACTATION.

	0-1.	1-2.	2-3.	3-4.	4-5.	5-6.
First period of lactation	.2	47.1	42.9	8.8	1.0	.01
Second period of lactation	.5	48.1	40.7	9.5	1.2	.04
Third period of lactation	.5	57.4	37.8	3.6	0.7	.02
Fourth period of lactation	.8	54.2	34.6	8.5	1.9	.02

TABLE 121. AVERAGE COMPOSITION OF FOOD EATEN AND MILK PRODUCED.

	1890.										1891.				
	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.
Average weight of animal	736	803	747	777	782	818	825	814	796	800	804	794	793	794	811
Number averaged	1	1	2	2	2	4	5	8	8	8	10	10	12	13	13
Average month of lactation	2	2	3	4	3	4	3	4	4.5	4.1	5.1	5.2	5.8	6.8	6.9
Average milk yield	626.10	573.60	607.80	603.00	557.40	703.80	605.40	563.40	533.50	532.60	552.90	487.30	510.60	486.60	511.50
Average per cent of fat in milk	3.96	3.91	4.42	4.56	4.73	4.35	4.75	4.47	4.53	4.72	4.42	4.28	4.36	4.26	4.14
Average per cent of casein in milk	3.23	3.15	3.77	4.10	3.74	3.28	3.29	3.22	3.51	3.43	2.99	3.31	3.67	3.48	3.75
Average pounds of fat in milk	24.30	22.40	26.90	27.60	26.50	30.10	28.00	24.70	23.80	24.50	23.60	20.00	21.80	20.20	20.70
Average pounds of casein in milk	21.20	18.10	33.00	24.70	20.90	22.70	19.40	18.00	18.50	18.20	16.40	15.80	18.50	16.80	19.00
Average pounds crude fat in food	22.90	21.80	25.30	30.00	27.00	26.80	19.60,	23.10	23.10	24.50	22.40	24.10	25.60	27.30	28.60
Average pounds albuminoids in food	53.20	55.00	61.60	68.50	77.50	70.50	47.90	49.40	52.70	54.80	46.30	53.20	58.30	64.50	60.60
Average pounds carbohydrates in food	263.30	282.00	314.90	304.40	299.80	309.60	228.40	268.10	274.70	283.90	310.30	288.50	289.20	267.00	259.70
Pounds of milk to one pound albuminoids in food	11.80	10.40	9.90	8.80	7.20	10.00	12.60	11.40	10.10	9.70	11.90	9.20	8.80	7.60	8.40
Pounds of milk to one pound carbohydrates in food	2.40	2.00	2.00	2.00	1.90	2.30	2.70	2.10	1.90	1.90	1.80	1.70	1.80	1.80	2.00
Pounds crude fat in food to one pound fat in milk	0.94	0.97	1.05	1.09	1.02	0.89	0.70	0.94	0.99	1.00	0.95	1.21	1.17	1.35	1.38

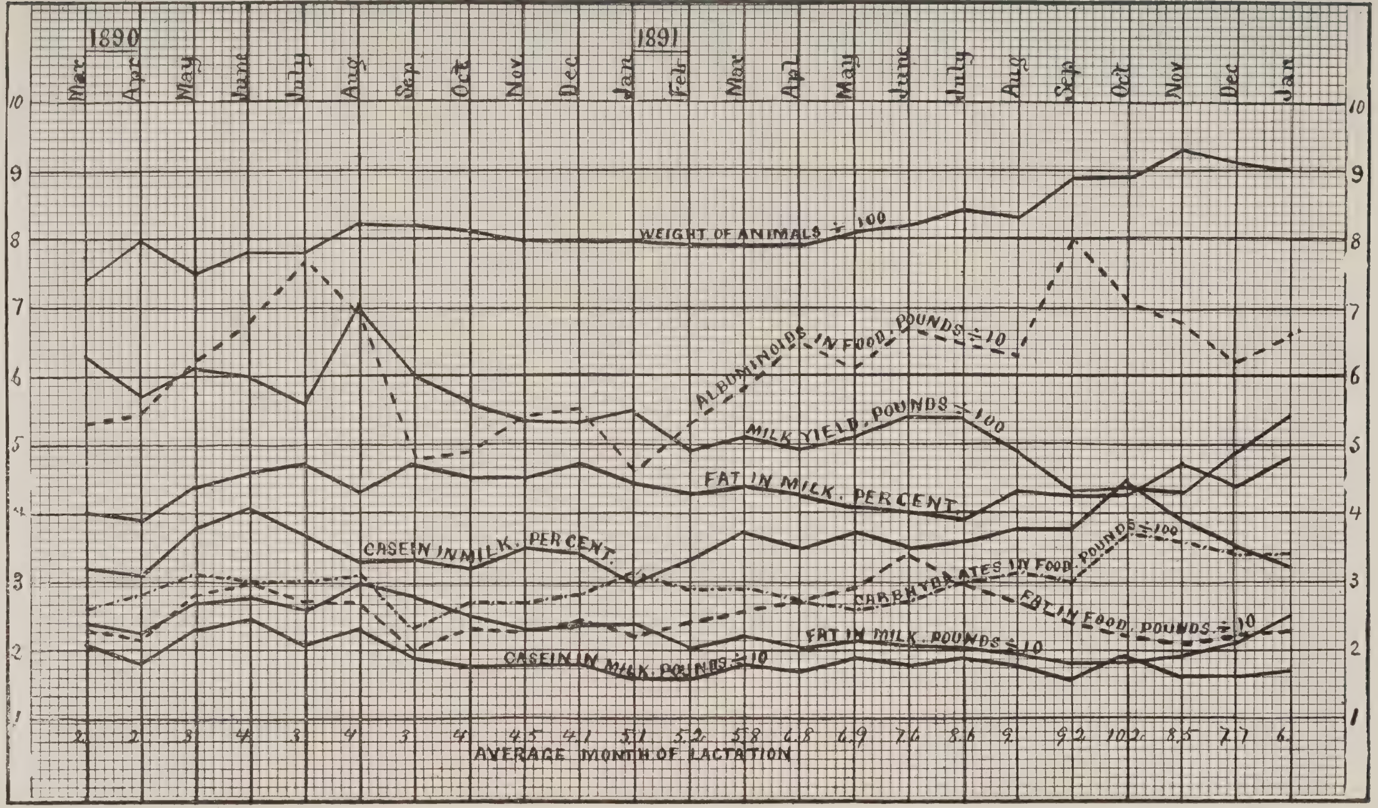
TABLE 122. AVERAGE COMPOSITION OF FOOD EATEN AND MILK PRODUCED — (*Continued*).

	1891.							1892.							
	June.	July.	August.	September.	October,	November.	December.	January.	Februa.y.	March.	April.	May.	June.	July.	August.
Average weight of animal	823	837	831	888	892	934	914	905	897	879	847	865	865	864	876
Number averaged	14	14	14	11	11	9	13	12	8	12	11	16	18	18	16
Average month of lactation	7.6	8.6	9.0	9.2	10.2	8.5	7.7	6.0	4.4	4.6	4.8	4.6	5.2	5.9	5.1
Average milk yield	536.50	541.20	493.50	434.50	443.70	428.80	494.00	537.00	562.20	563.40	509.20	571.00	599.10	612.80	538.70
Average per cent of fat in milk	3.99	3.94	4.33	4.31	4.29	4.69	4.43	4.80	4.53	4.53	4.76	4.28	4.07	3.65	4.10
Average per cent of casein in milk	3.50	3.63	3.76	3.75	4.39	3.86	3.50	3.22	3.54	3.52	3.53	3.26	3.23	3.17	3.42
Average pounds of fat in milk	20.50	20.20	18.50	18.00	18.30	18.80	20.90	25.30	19.90	26.10	25.50	26.20	25.50	23.00	21.70
Average pounds of casein in milk	18.40	19.20	18.20	16.10	19.10	16.20	15.80	16.90	16.00	20.50	18.70	20.20	20.90	20.10	18.60
Average pounds crude fat in food	33.60	29.90	27.00	23.60	22.40	21.80	22.10	22.70	16.30	24.70	26.50	28.10	33.60	40.60	41.10
Average pounds albuminoids in food	67.00	65.40	63.40	80.40	71.50	68.40	62.20	66.40	52.80	62.00	45.50	45.60	66.90	68.10	88.40
Average pounds carbohydrates in food	269.70	295.50	308.00	302.70	373.90	364.90	328.50	335.50	275.00	341.50	295.50	309.80	283.60	360.70	345.60
Pounds of milk to one pound albuminoids in food	8.00	8.30	7.80	5.40	6.20	6.30	7.90	8.10	10.60	9.10	11.20	12.50	9.00	9.00	6.10
Pounds of milk to one pound carbohydrates in food	2.00	1.80	1.60	1.40	1.20	1.20	1.50	1.60	2.00	1.70	1.70	1.90	2.10	1.70	1.60
Pounds of crude fat in food to one pound fat in milk	1.64	1.48	1.39	1.31	1.22	1.16	1.06	0.91	0.82	0.95	1.04	1.07	1.32	1.77	1.89

TABLE 123. AVERAGE COMPOSITION OF FOOD EATEN AND MILK PRODUCED — (*Concluded*).

	1892.				1893.										
	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.
Average weight of animal	897	909	948	941	964	974	968	1014	941	914	904	911	925	928	905
Number averaged	13	13	13	12	12	12	12	9	11	13	12	11	11	9	8
Average month of lactation	5.0	4.8	4.5	3.9	4.6	4.8	5.8	5.3	4.2	3.9	4.6	4.4	5.4	5.9	7.0
Average milk yield	578.90	598 50	619.40	710.00	679.20	572.80	634.50	644.20	643.80	665.20	697.30	653.50	673.90	604.10	517.90
Average per cent. of fat in milk	3.80	4.14	4.24	4.24	4.68	4.90	4.75	4.68	4.86	4.64	4.33	4.37	4.42	4.88	5.16
Average per cent. of casein in milk.	3.35	3 49	3.56	3.62	3.57	3.58	3.51	3.42	3.45	3.25	3.33	3.18	3.40	3.65	3.66
Average pounds of fat in milk	20.60	22.90	24.50	28.00	29.90	25.00	21.20	29.00	30.20	29.50	28.10	28.00	28.80	28.40	25.80
Average pounds of casein in milk	18.30	19.90	21.10	24.50	23.30	19.90	21 80	21.30	21.70	21.00	22.50	20.40	22.50	21.60	18.50
Average pounds of crude fat in food	38.60	42.30	34.20	33.70	36.20	29.70	33.20	38.30	30.20	31.30	33.30	41.60	46.20	38.50	24.60
Average pounds of albuminoids in food	88.70	72.20	71.10	97.20	93.50	77.30	86.80	71.40	55.70	74.40	83.30	79.10	83.80	72 80	50.10
Average pounds of carbohydrates in food	327.20	429.30	378.60	419.60	390.90	317.10	353.80	381.40	299.70	286.20	313.50	318.70	410.30	390.60	319.30
Pounds of milk to one pound albuminoids in food	6.50	8.30	8.70	7.30	7.30	7.40	7.30	9.00	11.60	8.90	8.40	8.30	8.00	8.30	10.30
Pounds of milk to one pound carbohydrates in food	2.00	1.80	1.60	1.40	1.20	1.20	1.15	1.60	2.00	1.70	1.70	1.90	2.10	1.70	1.60
Pounds crude fat in food to one pound fat in milk	1.87	1.84	1.40	1.20	1.21	1.19	1.57	1.32	1.00	1.08	1.19	1.49	1.60	1.36	.95

AVERAGE COMPOSITION OF FOOD EATEN AND MILK PRODUCED



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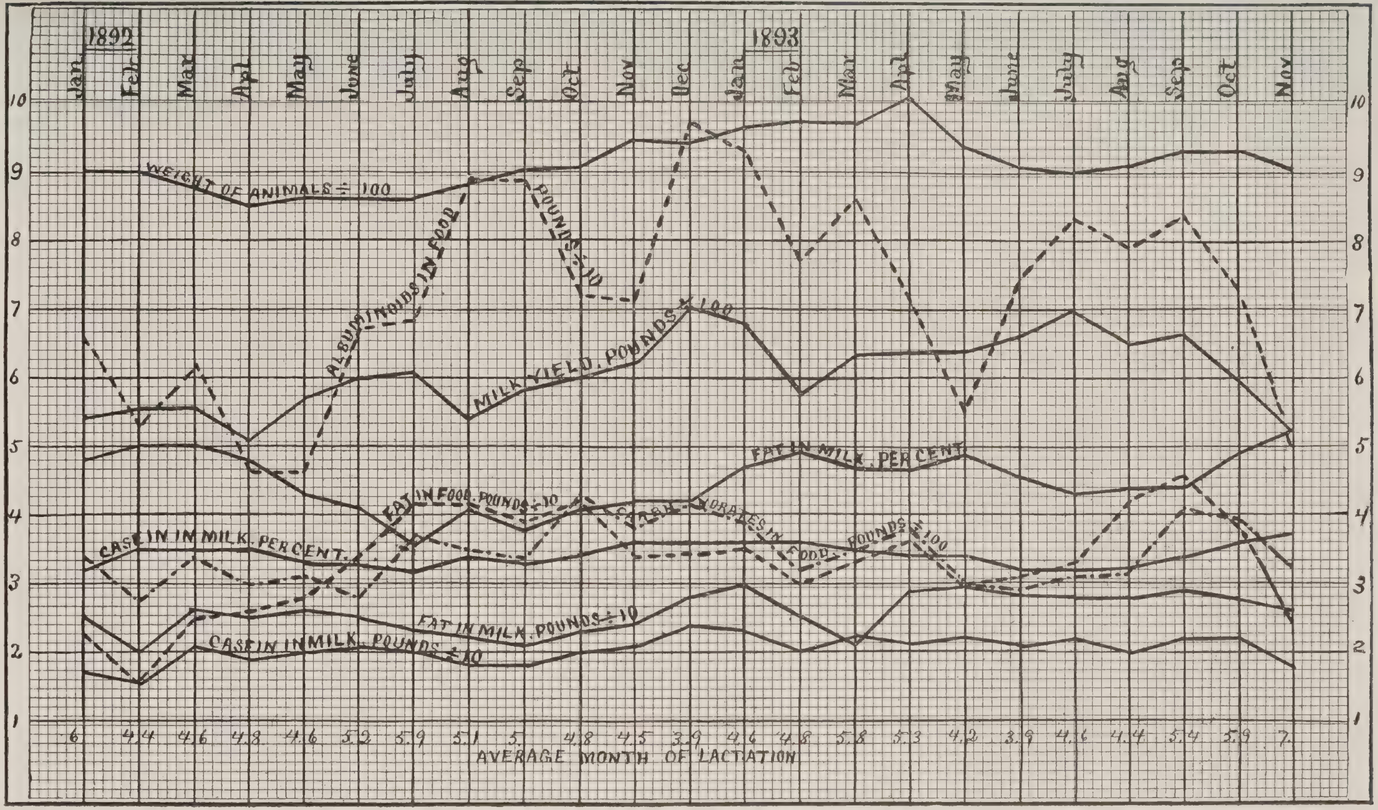

Explanation of the Preceding Tables.

In presenting the work done in the several investigations connected with the test of dairy breeds it has seemed best to present, as has been done, the data already secured and reserved its discussion to the last, in order that each one for himself may give attention mainly to such portions of the work as are of greatest interest to him.

Table 1 presents the dates of birth and of the several periods of calving of each animal under investigation.

Tables 2, 3, 4 and 5 are continuations from the eleventh annual report of the food fed these cows during the investigation. These tables will be found of great value to those who are anxious to study the effect of different kinds of feed and of seasons upon the milk and butter production of milch cows, and by comparing the several features of the results given in the subsequent tables, each for himself may with profit study this question which is of such vital importance to the practical dairyman.

Table 6 gives the composition by weight of the several grain mixtures fed during the past year, and is practically a continuation of a similar table published in the eleventh annual report.

Table 7 gives the chemical composition of the different foods fed to the animals, and the time during which such foods were fed.

Tables 8 to 11 inclusive, 16 to 21 inclusive, 28 to 30 inclusive, 34 to 39 inclusive and 46 to 55 inclusive present the constituents in pounds of the food fed to each of these animals during each month of the several periods of lactation, as also the weight of each animal for each month.

Tables 12 to 15 inclusive, 22 to 27 inclusive, 31 to 33 inclusive, 40 to 45 inclusive and 56 to 65 inclusive present for each animal the milk yield and the composition by per cent and by pounds of the milk for each month of the several periods of lactation.

Tables 66 to 82 inclusive, give the number of pounds of each of the food constituents consumed by each animal during each month of the third period of lactation; also the pounds of milk yielded by each cow and the percentage and number of pounds of each milk constituent for each animal in each month of the third period of lactation.

Tables 83 to 99 inclusive, give the results by breeds, presented in tables 66 to 82 inclusive, for individuals.

Table 100 gives the general average of all breeds for each month of the third period of lactation, giving the milk yield and its average percentage composition, and number of pounds of each food constituent consumed.

Table 101 gives the same average results for the second and third periods of lactation which are presented in table 100 for the third period alone.

The two diagrams following table 101 present graphically the average results given in that table.

Tables 102, 103 and 104 give the relation of fat in the food to that in the milk during the different periods of lactation.

Tables 105, 106 and 107 give the cost of production of milk and fat of the different animals in each period of lactation.

In connection with these tables, attention is called to an apparent discrepancy in the total fat yielded in the milk of certain cows in their first period of lactation, as was presented by some tables in the eleventh annual report. Where such difference is to be seen it is owing to the fact that in the eleventh report in certain cases only incomplete periods were given which had been completed in the present report. It is also to be observed that in some of these tables presented, records are given embracing more cows, and the results are therefore more complete and satisfactory.

Tables 108 to 110 inclusive, give the relative cost of production of milk and fat by the different animals in the successive periods of lactation, while table 111 gives the average results for three periods.

Table 115 gives the average food fed each animal each month during the entire experiment.

Table 116 gives the percentage variation by months both in food and milk constituents. This table is worthy of careful study, since one may perhaps be enabled to learn the effect upon milk and butter production of changes in the different food constituents, also such changes as are generally supposed to occur when cows are transferred from winter to spring or summer feeding.

Table 117 gives the number of days and average milk yield of of each cow in successive periods of lactation, as also the average for each breed and the general average of all. It will be observed that there is a gradual increase in the daily milk yield as the cows advance in age. Of course the evidence is yet limited for the third and fourth periods of lactation.

Table 118 gives the average yield, morning and afternoon milking, for each cow during the successive periods of lactation, and this table, as will be seen, is far more complete than the results hitherto given. It will be observed that the ratio of the evening milk is on an average 2.8 per cent less in the evening than in the morning.

Tables 119 and 120, giving the relative size and number of milk globules, in the different periods of lactation, from the different breeds, may be studied with interest. It will be seen that with advancing age apparently the average size diminishes, and as shown in table 120 the larger portion of the fat is in the later periods of lactation in smaller globules than it was during the first periods of lactation.

Tables 121, 122 and 123 present the average composition of foods eaten and milk produced by the different animals during the entire period of their investigation and while the animals were in apparent full flow of milk. So soon as an animal had dropped off to two-thirds of her maximum yield of milk she was not included in the results presented in this table. The number of pounds of milk compared with a pound of albuminoids and of carbohydrates in the food is presented, as also the amount of crude fat in the food as compared with the fat obtained in the milk. These tables present an opportunity to observe the effect not only of food constituents but of season in the average results obtained from a large number of animals, and the column giving the average month of lactation, as also the number of animals averaged, will enable one to make such slight allowances as may be needed for the effect produced by advancing lactation on the one hand, and the reliance which may be placed upon the results obtained in view of the number of animals included in the results. The diagrams following table 123 present graphically these same results, and it will be interesting to observe that between

November, 1892, and November, 1893, the lines representing the milk yield and the albuminoids in the food sustained a very interesting relation, while the per cent of fat in the milk during the same period is apparently uninfluenced by the albuminoids. This matter will be discussed more at length elsewhere in the report.

The Source of Fat in Milk.

It is of great importance that this question might receive an authoritative answer, especially since the increase of fat in milk by furnishing the proper ration is an end towards which our dairymen are striving.

Of course the first step towards such a result would appear to be a correct understanding as to the normal functions of the several food constituents, and in order that we may have a better understanding of the nature of the problem, the following brief summary of the nature of the digestive processes is taken literally from the elaborate works of Michael Foster, Professor of physiology in the University of Cambridge, England.

The Mechanism and Chemistry of Digestion.

Saliva. The chief purpose served by the saliva in digestion is to assist in mastication and deglutition. In some animals this is its only function. In other animals it has a specific solvent action on some of the food-stuffs. Such minerals as are soluble in slightly alakaline fluids are dissolved by it. On *fats* it has no effect save that of producing a very feeble emulsion. On proteids it has also no specific action, though pieces of meat, cooked or uncooked, appear greatly altered after they have been masticated for some time; the chief alteration, however, which thus takes place is a change in the hæmoglobin, and a general softening of the muscular fibers by aid of the alkalinity of the saliva.

Gastric juice. (Secreted into stomach.) The reaction is distinctly acid, and the acidity is normally due to free hydrochloric acid. This is shown by various proofs, among which we may mention the conclusive fact that the amount of chlorine present in gastric juice is more than would suffice to form chlorides with all the bases present, and that the excess if regarded as existing in the form of hydrochloric acid corresponds exactly to the quantity of free acid present. Lactic and butyric and other acids when present are secondary products, arising either by their respective fermentations from articles of food, or from the decomposition of their alkaline or other salts. In man the amount of free hydrochloric acid in healthy juice may be stated to be about .2 per cent, but in some animals it is probably higher.

On *starch* and *dextrose* gastric juice has no action. An excessive quantity of cane sugar introduced into the stomach causes a secretion of mucus, and hence provides for its own conversion into dextrose. On *fats* gastric juice has at most a limited action. When adipose tissue is eaten, the chief change which takes place in the stomach is that the proteid and gelatiniferous envelopes of the fat-cells are dissolved, and the fat set free. Though there is experimental evidence that emulsion of fats to a certain extent does take place in the stomach, the great mass of the fat of a meal is not so changed.

On proteids the action of the gastric juice is to convert the insoluble into soluble proteids. When the conversion is complete *peptones* are formed, the most soluble of all proteids; if the conversion is not complete, the proteids are left in one of the intermediate stages, namely, in the form of *albumose* or *parapeptone.*

The active principle of the gastric juice is a ferment body to which the name *pepsin* has been given.

Bile, action on food. In some animals at least bile contains a ferment capable of converting starch into sugar; but its action in this respect is wholly subordinate.

On proteids bile has no digestive action whatever, but being, generally at least, alkaline, and often strongly so, tends to neutralize the acid contents of the stomach as they pass into the duodenum and so prepares the way for the action of the pancreatic juice.

With regard to the action on fats, the following statements may be made:

Bile has a slight solvent action on fats, as seen in its use by painters. It has by itself a slight but only slight emulsifying power; a mixture of oil and bile separate after shaking rather less rapidly than a mixture of oil and water. With fatty acids bile forms soaps. It is moreover a solvent of solid soaps, and it would appear that the emulsion of fats is under certain circumstances at all events facilitated by the presence of soaps in solution. Hence bile is probably of much greater use as an emulsion agent when mixed with pancreatic juice than when acting by itself alone. Lastly, the passage of fats through membranes is assisted by wetting the membranes with bile, or with a solution of bile-salts. Oil will pass to a certain extent through a filter paper kept wet with a solution of bile salts, whereas it will not pass or passes with extreme difficulty through one kept constantly wet with distilled water.

Bile posesses some antiseptic qualities. Out of the body its presence hinders various putrefactive processes, and when it is prevented from flowing into the alimentary canal, the contents of the intestines undergo changes different from those which take place under normal conditions, and leading to the appearance of various products, especially of ill-smelling gases.

Pancreatic juice. The healthy juice is a clear, somewhat viscid fluid, having a decided alkaline reaction. On *starch* pancreatic juice acts with great energy, rapidly converting it into *sugar* (chiefly maltose). All that has been said in this respect concerning saliva might be repeated in the case of pancreatic juice, except that the activity of the latter is far greater than that of the former. On *proteids* pancreatic juice also exercises a solvent action, so far similar to that of gastric juice that by it *proteids* are converted into *peptone.* Also during the pancreatic digestion of proteids, two remarkable nitrogenous crystalline bodies appear, namely *leucin* and *tyrosin.*

On fats pancreatic juice has a twofold action. In the first place it emulsifies fats. If hog's lard be greatly heated until it melts and be then mixed with pancreatic juice before it solidifies on cooling, a creamy emulsion, lasting for almost an indefinite time, is formed. So also when olive oil is shaken up with pancreatic juice, the separation of the two fluids takes place very slowly, and a drop of the mixture under the microscope shows that the division of the fat is very minute. In the second place pancreatic juice splits up neutral fats into their respective acids and glycerine. This palmatin (or tripalmitin) is split up into palmitic acid and glycerine, and so with other neutral fats. If perfectly neutral fat be treated with pancreatic juice, especially at the body-temperature, the emulsion which is formed speedily takes on an acid recreation, and by appropriate means not only the corresponding fatty acids but glycerine may be obtained from the mixture. When alkali is present, the fatty acids thus set free form their corresponding soaps. Pancreatic juice contains fats, and is consequently apt after collection to have its alkalinity reduced; and an aqueous infusion of a pancreatic gland very speedily becomes acid.

Succus entericus is a secretion in the small intestines. It is said to convert starch into sugar, and proteids into peptones (the action being very similar to that of pancreatic juice), to split up neutral fats, to emulsify fats and to curdle milk. It is also said to convert rapidly cane-sugar into grape-sugar, and by a fermentative action to convert cane-sugar into lactic acid, and this again into butyric acid with the evolution of carbonic acid and free hydrogen. According to the above results succus entericus is to be regarded as an important secretion acting on all kinds of food. But even at best its actions are slow and feeble. Moreover many observers have obtained negative results, so that the various statements are conflicting. Besides we have no exact knowledge as the amount to which such a secretion takes place under normal circumstances in the living body. We may therefore conclude that at present at all events, we have no satisfactory reasons for supposing that the actual digestion of food in the intestine is, to any great extent, aided by such a juice.

I. Proteids. II. Fats. III. Carbohydrates (Sugar and Starches).

I. Proteids. The saliva has little or no action upon proteids, but serves principally to moisten them and also to render them alkaline, or at least to reduce their acidity before entering the stomach.

The proteids upon entering the stomach are acted upon by the gastric juice, and are changed from an *insoluble* to a *soluble* form. When the change is complete, the resulting form is *peptone.* However, much of the proteid remains unchanged, or at least, is not converted into peptone, but is reduced to the more uniform *chyme* and is thus prepared for the changes which takes place in the small intestine. The peptone formed in the stomach is probably absorbed at once.

The semi-digested acid food, or chyme, as it passes over the biliary orifice, causes gushes of bile, and at the same time the pancreatic juice flows into the intestine freely. These two alkaline fluids, especially the more strongly and constantly alkaline pancreatic juice, tend to neutralize the acidity of the chyme, but the contents of the duodenum do not become distinctly alkaline until some distance from the pylorus is reached.

To what stage the pancreatic digestion is carried, whether peptone is, practically, the only product, or whether the pancreatic juice in the body, as out of the body, carries on its work in the more destructive form, whereby the proteid material subjected to it, is so broken down as to give rise to appreciable quantities of leucin and tyrosin, is at present not exactly known. Leucin and tyrosin have been found in the intestinal contents, and may therefore be formed during normal digestion, but whether an insignificant quantity or a considerable quantity of the proteid material of food is thus hurried into a crystalline form cannot be definitely stated. The extent to which the action is carried is probably different in different animals, and probably varies also according to the nature of the meal and the condition of the body. Probably when a large and unnecessary quantity of proteid material is taken at a meal together with other substances, no inconsiderable amount of the proteids undergo this profound change, and rapidly leave the body as urea, without having been used by the tissues, their contribution to the energy of the body being limited to the heat given out during the changes by which they are converted into urea. As stated before, leucin is amido-caproic acid, a "fatty acid" compound, and tyrosin, is a phenyl compound and belongs to the "aromatic" series: hence pancreatic digestion is capable of breaking up proteids into "fatty acid" and "aromatic" compounds. We may say that the results of experiment, while they do not definitely prove, give some support to, and at least do not contradict, the view that proteids, transformed into diffusible peptones, pass into the blood vessels and not into the lacteals. Leucin probably takes the same course.

Concerning the changes that tyrosin undergo, all is uncertain and doubtful; possibly may be oxidized somewhere into carbonic acid and water.

II. *Fats.* In the mouth fat undergoes no change, except when some of it is formed into a very feeble emulsion. On the fats that enter the stomach, the gastric juice has at most, a limited action. In pieces of tissue containing fat, the connecting tissue binding the fat cells together and the envelopes of the fat cells are dissolved, so that the fat fluid at the temperature of the body, is set free from the individual cells and runs into larger and smaller masses. Next in order the bile has a slight solvent action on some of the fats and also makes an emulsion with some of the fats. With the fatty acids present the bile forms soaps. The pancreatic juice also emulsifies some of the fats and also splits a little up into free fatty acids and glycerine, but by far most of them remain as neutral fats. The neutral fats so emulsified pass in the first instance into the bodies of the columnar cells of the villi. How the fat enters into the substance of the cell we do not know. From the columnar cell the fat passes into the spaces of the reticular tissue of the villus. From the labyrinth of spaces of the reticulum of the villus, the fat passes into the cavity of the lacteal radicle. Up to this point it was merely emulsified fat, but after passing into the lacteal radicle it becomes "chyle."

The condition of the fat in chyle is peculiar. Some of it exists, like the fat in milk, in the form of fat globules of various sizes, but all small. A very considerable quantity, however, is present in the form of exceedingly minute spherules or granules, far smaller than any globules to be seen in milk.

We may probably infer with safety that all or at least very nearly all the fat absorbed from the intestine takes the path of the lacteals. It may be that in some way, on its course, in the lymphatic glands, for instance, the fat is taken away from the chyle, hidden so to speak somewhere away from both chyle and blood; but on this point we have no exact information. We might infer from this that an excess of fat thus entering the blood would naturally be disposed of by being simply stored up in the available adipose tissue without any further change; we can imagine that the fat, not immediately wanted by the economy, passes in some way from the blood to the connective tissue (the white blood corpuscles which appear loaded with fat after a meal possibly acting as intermediaries), and that the connective tissue corpuscles swallow the fat brought to them after the fashion of an amoeba, not digesting it but simply keeping it in store until it was wanted elsewhere.

III. *Carbohydrates.* The general action of saliva is that of converting starch into some form of sugar. The action of saliva varies in intensity in different animals. Thus in man, the pig, the guinea-pig, and the rat, the actions are amylolytic (convert starch into sugar); while in the horse, sheep and ox the amylolytic powers are extremely feeble.

Saliva converts boiled starch into sugars. Some dextrose is formed, but the greater part of the sugar which appears is in the form of maltose. Raw unboiled starch undergoes a similar change but at a much slower rate. This is due to the fact that in the curiously formed starch grain the true starch, or *granulose*, is invested with coats of *cellulose.* This latter material is apparently not acted upon by saliva. Hence the saliva can only get at the granulose by traversing the coats of cellulose, and the conversion of the former is thereby much hindered and delayed. The sugars and starches upon entering the stomach are not acted upon to any appreciable extent by the gastric juice. The bile also exercises very little action upon the carbohydrates.

On *starch*, pancreatic juice acts with great energy, rapidly converting it into sugar (chiefly maltose). All that has been said in this respect concerning saliva might be repeated in the case of pancreatic juics, except that the activity of the latter is far greater than that of the former.

By fermentation in the intestine some of the sugar is removed from the carbohydrate group into the fatty acid group; it is thus, so to speak, put on its way to become fat.

We can not as yet trace out the steps nor can we definitely point to any particular tissues other than the fat-cells themselves as the seats of any such changes. Having reached the intestine the carbohydrates taken as food are in the form of sugars, and we have reason to think that a very large part at all events of the carbohydrate material of a meal is absorbed as sugar by the capillaries of the intestine and carried as sugar to the liver in the portal blood. The sugar carried to the liver, becoming through some action of the hepatic cell-substance dehydrated into glycogen or animal starch, as it has been called, the process being a reverse of that by which in the alimentary canal starch is hydrated into sugar through the action of the salivary and pancreatic ferments.

The glycogen that is stored up in the liver may from time to time be converted into fat and used in the animal economy, but there is no certain evidence upon this fact. Part of the glycogen at least, previously stored up in the liver is from time to time reconverted into sugar and is slowly discharged into the hepatic blood for use in the body.

Waste Products.

The elimination of waste products of the body takes place mainly through the lungs, the skin and the kidneys, the former excreting carbonic acid, the latter urea, salts and water, while the skin eliminates water and some salts. The undigested portion of the food together with small portions of the several secretions poured into the alimentary canal, escape in the faeces.

In his Manual on Cattle Feeding, Dr. Armsby, who has made a careful study of the results obtained, mainly in Europe, up to 1880, says, in speaking of the *Formation of Fat in the Body* that "for the fact of the formation of fat in the body from other substances no special proofs need be adduced: it is sufficiently evident from daily experience, especially in fattening and in milk production."

To such sweeping assertion, most decided objection must be made, and an entire dissent from the statement that "daily experience, especially in fattening and milk production" proves or even renders it probable that the fat stored up in the body or secreted in the milk is produced from any other constituent of the food than the fat.

A careful survey of the matter as it is presented by Dr. Armsby, fails to show me a single argument which clearly establishes such a fact, unless we except only the case of the fly's eggs hatched in and fed upon blood. The experiments cited where dogs were fed solely upon fat, free from meat and failed to excrete all the carbon ingested, by no means proves that such carbon was stored up in their bodies as fat, and yet it is added that "many other similar experiments showing a formation of fat from albuminoids might be adduced."

In reference to the Moeckern experiments on the production of milk fat by cows, Dr. Armsby says: "whether the fat of the body took part in the milk production, as is so often the case with milk cows, even when well fed, could only have been decided with certainty by the help of a respiration apparatus."

Again he says, "a dog weighing about twenty kilogrammes, after thirty days of fasting, was fed for five days with the greatest possible quantities of pure fat, of which on an average of 370.8 grammes daily were digested. In the body of the animal, which was killed at the end of the experiment, 1352.7 grammes, of fat were found on the various organs, instead of the 150 grammes, which according to other investigations, was the greatest amount that could have been present in the body after thirty day's fasting, so that in this case about 250 grammes daily of the fat of the food remained undestroyed and were deposited within the body. In numerous other experiments on dogs, too, with a more normal food of meat and fat, and with the help of the respiration apparatus, the fact has been confirmed that often a very considerable part of the fat of the food may be retained in the body."

Again he says, "the fat in the fodder of the herbivora is not prevented from contributing directly to the deposition of fat in the body, since most of the vegetable fats are very similar in their composition and properties to the animal fats." Why could he not have said that they were identical? In what does the vegetable oils, as olein, stearine, palmatine, differ from these same oils which are found in the animal body?

But we note the distinct admission here of two well known facts in the quotations I have made, viz.:

1. That in the case of milk cows, the fat of the body takes part in milk production, and

2. That upon a diet of pure fat, a large amount of body fat was daily produced.

Again he says "that fat can be formed from the albuminoids is now denied by no one acquainted with the subject," and yet this statement is by no means so strong as at first reading it would appear, and no one familiar with the elements of chemistry would deny that it was in a certain sense possible, or at least conceivable, that any compound composed of carbon, hydrogen and oxygen might be produced from another compound containing these same elements, even though nitrogen might also be combined with them, though pretty positive proof is needed to show that such compounds are so formed, and such positive proof, so far as I can see, appears at present to be wanting.

There is danger in our conclusions when we confound the chemical changes resulting from decay, decomposition or disease with those which are produced during normal and vital processes, and we easily discriminate between these numerous products, those needed in the several parts and functions of the animal organism, and those which are recognized as either foreign to the healthy development of the animal, or as the waste products of food or tissue which has already fulfilled its work. Indeed we may question also the application of facts derived from the investigation of animals which are wholly unrelated to those we have under consideration, as for example, the comparison of the Carnivora or Insectivora with the Herbivora and in this connection it is to be observed that these principles under discussion have been laid down by many as though almost beyond question established and mainly based upon facts derived in the very way above indicated. For example, "the liver of a man who died of phosphorous poisoning contained in its dry substance the enormous amount of 76.8 per cent of fat." The implication is that this fat was produced by a conversion of the nitrogenous tissue of the liver into fat, which may possibly be the fact, but there is no evidence whatever to sustain it. In like manner we might claim that the chalky concretions of gout were a conversion of the muscular tissue. Again "the formation of a so-called adipocere also favors the view that fat can be formed from the albuminoids," but when we consider that the act of formation of this peculiar substance, has from the very nature of the case, never been observed, that nothing in the way of qualitative results exist to show that this interesting substance contains a fraction of a per cent more of fat than did the dead body from which it was produced and that the sole remaining trace of muscular tissue is the ammonia which constitutes in part this adipocere, I think we shall be forced to admit that the formation of this compound adds very little support to the view that fat is produced from albuminoids.

Again it is said that "it has also been observed, that in the milk of the same cow the quantity of albuminoids frequently decreases when that of the fat increases, and the reverse," but the reader hardly needs to be reminded that the above statements, if true, may be, as doubtless they could be accounted for upon any one of a score of suppositions, each equally as plausible as that the amounts of fat and albuminoids in the milk were mutually convertible, of which supposition these facts related offer not even the shadow of proof.

"If a doubt still remained," says Professor Armsby, as to the formation of fat from albuminoids, it must disappear on a consideration of the results which have been obtained on healthy animals with an entirely normal food. For example, the eggs of ordinary flies have been allowed to develop on pure blood and from seven to eleven times as much fat found in the larvæ as was originally contained in the eggs and blood together; the excess of fats could only have come from the albuminoids of the food."

The brief review presented of the several steps of the process of digestion shows that, while the other food constituents which are digested by the animal are during this digestive process subject to more or less profound chemical changes before being fitted for their several functions in the body, fat upon the other hand is not known to suffer other than purely mechanical changes, unless indeed the setting free of a certain portion of the fatty acids may be regarded as established, of which, however, there is doubt, while as has been shown the fat has been actually traced through every step of its course unchanged from the food eaten to the milk secreted in the udder, or to the stored up fat accumulated in the body.

If it could be clearly demonstrated that a cow did for a long season produce more fat in her milk than careful analysis would reveal in her food, there could be no escape from the conclusion that such excess of fat produce must have been derived from other portions of her food, but such testimony, so far as I know, is wanting, while the experiments at this station, continued now for several years, appear to show that as a whole the several cows under experiment actually consume a larger amount of fat in their food than they produce in their milk, and it must be remembered that they are reasonably well fed, and fairly represent their several breeds in milk production.

Before discussing our own results let us consider the data, so far as we have it, in connection with the recent ninety-day dairy contest between twenty-five selected representatives of each of the following breeds: Jerseys, Guernseys and Shorthorns.

Ninety-day Test at Chicago.

During this ninety-day test of three breeds of dairy cattle at the Columbian Exposition, twenty-five animals of each breed having been selected for the purpose, the results obtained even in this trial of most carefully selected animals, when the products of milk and butter, if not phenomenal, were, at least, far beyond the average, there is good reason to believe that all the fat recovered in the milk was furnished these animals in the fat of the rations fed them without demand being made upon any other constituent present in the food consumed by them.

The Jersey Bulletin of December 20, 1893, gives the following data concerning the test:

The columns of per cents of crude fats and of fat digestible, are obtained mainly from the average given in the Handbook of American Feeding Stuffs, and as especial care was taken in this important trial to secure the very best of each food fed, it is a reasonable conclusion that the amount of fat and of other food constituents also was larger than these average percentages indicate.

FOOD FED DAIRY CATTLE DURING NINETY-DAY TEST AT COLUMBIAN EXHIBITION.

	Jerseys.	Guernseys.	Shorthorns.	Per cent crude fat.	Per cent digestible.
Old hay	7940.3	14343.0	13545.0	4.19	1.34
Silage	4617.0	582.0	51707.0	.79	.68
Oil meal	4667.0	2465.5	2180.0	7.91	7.10
Bran	11992.5	13040.5	10853.5	4.03	3.52
Corn hearts	12748.5	7430.0	9864.5	5.83	4.46
Middlings	9452.5	4018.5	5773.5	3.97	3.52
Cotton-seed meal	2962.3	2063.0	3277.0	13.08	12.50
Cream gluten	....	1894.0	2973.6	16.15	12.36
Oats	2561.0	168.3	2078.0	4.99	4.17
Green clover	27788.3	16110.0	726.0	1.20	.55
Swale grass	240.0	615.0	....	.65	.51
Grano gluten	867.0	3304.5	1662.0	15.78	12.07
New hay	13270.9	11775.0	9565.4	4.19	1.34
Corn meal	....	1100.8	705.0	3.77	3.25

PRODUCTION OF MILK AND FATS DURING NINETY-DAY TEST.

Milk	73488.8	61781.7	66263.2	......	....
Fat in milk	3516.1	2784.6	2410.0	......	....
Live weight gained	776.0	365.0	2803.0	......	....

Pounds Fat.

	Pounds fat.	Pounds live weight gained.	Pounds old hay.	Pounds ensilage.	Pounds oil meal.	Pounds wheat bran.	Pounds corn hearts.	Puunds wheat middlings.	Pounds cotton-seed meal.	Pounds cream gluten.	Pounds ground oats.	Pounds green clover.	Pounds swale grass.	Pounds grano gluten.	Pounds new hay.	Pounds corn meal.
Jersey	3516.08	776.0	7940.30	4617.00	4667.00	11992.50	12748 50	9452.50	2962.25	....	2561.00	27788.30	240.00	867.00	13270.90	....
Crude fat	....	....	333.60	36.47	369.16	483.30	743.24	375.26	387.46	....	127.79	333.46	1.56	136.81	556.05	....
Guernsey	2784.56	335.0	14343.00	582.00	2465.50	13040.50	7430.00	4018.50	2063.00	1894.00	168.25	16110 00	615.00	3304.50	11775.00	1100.75
Crude fat	....	....	600.97	4.60	195.02	525.53	433.17	159.53	269.84	305.88	8.40	193.32	4.00	521.45	493.37	41.50
Shorthorn	2409.97	2803.0	13545.05	51707.40	2180.00	10853.50	9864.50	5773.50	3277.00	2973.60	2078.00	726.00	....	1662.00	9565.40	705.00
Crude fat	....	....	567.54	408.49	172.44	437.40	575.10	229.21	428.63	480.24	103.69	8.71	....	262.26	400.79	26.58
Jersey	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Digestible fat	....	....	106.40	31.40	331.36	422.14	568.58	332.73	370.28	....	106.79	152.84	1.22	104.65	177.83	....
Guernsey	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Digestible fat	....	....	192.20	3.96	175.05	459.03	331.38	141.45	257.87	234.10	7.02	88.60	3.14	398.85	157.78	35.77
Shorthorn	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Digestible fat	......	......	181.50	351.60	154.78	382.04	439.96	203.23	409.62	367.54	86.65	3.99	....	200.60	128.18	22.91

	Pounds fat eaten.	Pounds fat digested.	Pounds fat in milk.
Jerseys	3884.2	2706.2	3516.1
Guernseys	3756.6	2486.2	2784.6
Shorthorns	4101.1	2932.6	2410.0
Total	11741.9	8125.0	8710.7

It appears that there was upon an average 7.2 per cent more fat recovered in the milk than was digested in the food fed; also that there was upon an average 69.2 per cent of the fat in the food actually digested according to the tables used in compilation of these results; also that had 74.2 per cent of the fat of the food digested, it would have equalled the amount recovered in the milk.

In this connection it is to be considered that over eighty per cent of the digestible fat is in the highly concentrated mill feeds and grain, the average of digestible fat in which has been estimated above at 6.99 per cent, while had it been only 0.38 per cent more, or 7.37 per cent, it would have been sufficient to meet all demands upon the animal for the fat produced in the milk and the increase in live weight of the animals during the trial, for which 3944 pounds of total increase in live weight 8.7 per cent, or 343 pounds of fat are allowed.

Those familiar with the variation in the consumption of these concentrated food-products will not think that the allowance of 0.38 per cent remarkable, nor unlikely in the case of these having been chosen with especial care, nor when we consider that in our most carefully conducted digestion experiments a difference of a few per cent in the coefficient of digestibility is quite within the range of probable error.

Results of Our Own Work.

By reference to Tables 112, 113, 114 it will be seen that twenty-three cows in their first period of lactation, eighteen in their second period, and ten in their third period consumed of albuminoids, carbohydrates and crude fats and yielded fat in their milk as follows:

Number cows.	PERIOD OF LACTATION.	Albuminoids.	Carbohydrates.	Crude fat in food.	Pure fat in food.	Fat in milk.
23	First	22911.2	113388.1	9958.9	8226.1	6810.2
18	Second	14063.1	68023.7	6454.7	5331.6	4363.2
10	Third	6733.6	30964.7	3166.5	2615.5	2272.0
	Total	43707.9	212556.5	19580.1	16173.2	13445.4
	Ratio	3.25	15.81	1.46	1.20	1.00

There was during these three periods an average increase of 161 pounds, or a total of 3134 pounds in the live weight of the animals under experiment, and if we assume the estimate of 8.7 per cent as the amount of fat represented in this gain, it will amount to 272.7 pounds, which, added to the fat of the milk, will give 13718.1 pounds as the fat produced by these animals.

If now we allow the crude fat of the food to contain 17.4 per cent of impurities, there would remain 82.6 per cent, or 16173.2 pounds of pure fat in the food eaten by these animals, or eighteen per cent more fat than was produced by them in their milk or increase in weight. This will present a loss of 15.3 per cent of the pure fat through lack of digestibility, a loss greater than appears to exist in many experiments made, though H. J. Patterson, in a series of digestion experiments with steers, reported in *Agricultural Science* for January, 1892, gives the following as the percentage of fat digested in several trials with different rations:

EXPERIMENTS.	Food fed in experiments.	Per cent fat digested.	
First	Stover, corn meal, cotton-seed meal.	79.12	82 89
Second	Silage, corn meal, cotton-seed meal.	78.17	84.84
Third...... ...	Silage, corn meal................	74.11	.....
Fourth.........	Silage, gluten meal, germ feed....	87.25	84.76
Fifth	....	81.16	81.72
Sixth	....	87.27	87.11

The average digestibility of fat in the eleven trials was 82.58 per cent, a result according very closely to those secured in our experiments.

In connection with the very close agreement between the amount of fat present in the food and digested by the animal and that actually recorded as fat in the milk, which agreement would suggest strongly the probable source of the latter, and on the other hand the lack of any similiar relation as to quantity between the fat produced and the amount of other constituents of the food, and especially in view of our present knowledge of the physiology of food digestion, it would seem that until strong proof shall be submitted that the fat of milk is derived from other constituents of the food, its source at present must be held as the fat present in the food of the animal.

It is proposed to make other experiments the coming season to clear up this point if possible.

It is obviously far from established by the preceding experiment that all, or in fact any of the fat produced by the animal is derived from the fat present in the food, but it seems highly probable that such is the fact. In the case of certain animals and certain herds, there is evidence, which, upon careful investigation, may prove, whatever may be the general source of fat, that there is in the animal economy the power of converting either albuminoid or carbonaceous food, or both, into fat.

It is hoped that our further investigations of this matter may afford a solution of this important question.

Exhibit of Fruits and Vegetables at the World's Fair.

Complying with the requests of Mr. George T. Powell, director of the New York horticultural exhibit at the Columbian exposition, and his assistants, Messrs. E. G. Fowler and George C. Snow, this station sent frequent exhibits of fruits and vegetables to the exposition throughout the season. The exhibit of fruits consisted of:

1 *Strawberries.*— Forty varieties of potted strawberry plants in fruit, including twenty-nine of the crosses produced at this station, and also the fruit of thirty-four varieties from the Station beds.

2 *Currants.*— Twenty-five varieties of currants, including nine black, twelve red and four white varieties.

3 *Gooseberries.*— The gooseberry exhibit made by this Station at Chicago undoubtedly constituted the finest collection of gooseberry fruits ever placed on exhibition in America. It included one hundred and sixty-seven varieties, of which number twenty-seven originated at this Station and have not yet been named or disseminated. Exclusive of Station seedlings not yet fruited, there are two hundred and thirty-seven kinds of gooseberries growing on the Station grounds. Two hundred and twenty-six of these are European varieties or their seedlings, and eleven are derived wholly or in part from species indigenous to America.

4 *Stone Fruits.*— A few peaches and plums were sent to the exposition. There were but very few varieties of European plums in the Station orchard that fruited in 1893; those which were shipped were chiefly of American or Japanese origin.

5 *Pomaceous Fruits.*— Seventeen varieties of pears and ninety seven varieties of apples and crab-apples were sent to the exposition.

6 *Grapes.*— One hundred and fifty-four kinds of grapes were placed on exhibition; six of these were from wild vines native to America, and 148 were cultivated varieties. All were grown in the station vineyards which contain eighteen species of wild vines and 239 cultivated sorts, including several station seedlings which have borne fruit.

7 *Sprayed fruit.*— Samples of fruiting branches and of fruit from sprayed and unsprayed pear trees were forwarded to Chicago at various times during the season.

The vegetable exhibit made by this Station at Chicago was of especial interest and importance, since by its aid New York State was enabled to keep a constant exhibit of fresh vegetables throughout the season, and was the only State that did this. The nature of this exhibit is fully discussed in the Horticulturist's report in another portion of this volume. The summary of the exhibits herewith given will serve to show their number and variety. It includes those sent to the State Fair at Syracuse, since during that week no shipments were made to Chicago.

NAME.	Number of varieties.	Number of exhibits.	Number of specimens.	Number of boxes.
Bush beans	28	139	......	139
Bush Lima beans	5	17	......	17
Pole Lima beans	7	13	......	13
Beets	17	103	618	....
Beets, Swiss chard	3	21	126	....
Carrots	16	87	522	....
Corn, sweet	32	93	767	....
Corn, pop	5	14	130	....
Cress	2	2	......	2
Cucumbers	29	226	1,510	....
Egg plant	1	2	7	....
Lettuce	41	131	624	....
Muskmelons	17	27	115	....
Watermelons	1	1	2	....

NAME.	Number of varieties.	Number of exhibits.	Number of specimens.	Number of boxes.
Okra	2	17	.....	17
Onions	27	104	782	....
Parsnips	1	2	22	....
Peas	51	105	......	105
Peppers	27	37	684	....
Radishes	39	305	5,690	....
Squash	21	121	658	....
Tomatoes	54	443	4,916	....
Turnips	7	6	36	....
Totals	433	2,016	17,209	293

List of Awards for the Station Exhibits Granted by the World's Fair Commissioners.

1. Variety of currants.
2. Variety of gooseberries.
3. Illustration of benefits of spraying fruits.
4. Collection of grapes.
5. Collection of sweet corn.
6. Collection of peas.
7. Collection of bush beans.
8. Collection of lima and other pole beans.
9. Collection of summer squashes.
10. Collection of winter squashes.
11. Collection of tomatoes.
12. Collection of peppers.
13. Collection of cucumbers.
14. Collection of muskmelon or cantelope.
15. Collection of onions.
16. Collection of radishes.
17. Collection of salsify.
18. Collection of beets.
19. Collection of carrots.
20. Collection of lettuce in variety.

This Station exhibited at the State Fair at Syracuse 355 varieties of vegetables, comprising about 3,943 specimens, besides seven boxes of lima beans and three boxes of cress; also a few pears, plums and peaches, ninety-nine kinds of apples and 129 kinds of grapes. Similar exhibits of fruits and vegetables, though not quite so extensive, were sent to the local fairs at Geneseo, Hornellsville and Canandaigua.

During the year the several members of the staff have, so far as was practicable, attended the Farmers' Institutes throughout the State, and given addresses at granges, clubs, horticultural societies and similar organizations of farmers.

It seems desirable that this method of bringing the work of the Station to the direct attention of the farmers should be largely increased, since the demand for such service among the farmers grows steadily more and more pressing.

Sugar Beets.

The following results were obtained in the analysis of several varieties of sugar beets grown on the station grounds, besides one specimen received from Riverhead, L. I.

ANALYSES OF JUICES.

VARIETY.	Specific gravity.	Per cent sugar.
Austria electric Wobauka beet	1.065	12.41
Yellow globe Mangel Wurzel beet	1.052	9.49
Vilmorin improved sugar beet	1.071	13.87
Mammoth golden Mangel Wurzel beet	1.062	12.07
Golden Tankard Mangel Wurzel beet	1.048	8.78
Mammoth long red Mangel Wurzel beet	1.050	8.39
Lane's sugar beet	1.060	11.56
Sugar beet from James L. Millard, Riverhead, N. Y.	1.050	8.46

Sugar in Corn Stalks.

Average samples from three varieties of the stalks of sweet corn, from which the ears had been plucked for the canning factory at Geneva, were secured for analysis, and the following results were obtained:

ANALYSES OF JUICES.

VARIETY.	Specific gravity.	Per cent sugar.	Per cent. glucose.
Egyptian	1.049	6.88	2.72
Stowell's evergreen	1.065	9.44	2.72
Hickoks	1.067	10.09	2.32

The average weight of these stalks after the ears had been removed was 21.2 ounces, and after the tops and blades had been removed 13.6 ounces. Allowing the corn to be planted in hills four feet by four and four stalks in a hill, the weight of topped and stripped stalks per acre would be 9,257 pounds.

For purposes of comparison, the following results are given as the average for four years from the juices of sugar cane grown in Louisiana. Sugar, 10.67 per cent; glucose, 1.73 per cent.

It will be seen, therefore, that for the production of syrup, which would take both sugars, the cornstalk juice contained 11.4 per cent, or nearly 92 per cent of that present in the sugar-cane juice, and, since many hundreds of acres of corn are being grown for canning purposes, it seems to be quite worth while to attempt the manufacture of syrup from the stalks, especially since the bagasse left after having expressed all the juice which could be secured by a mill, would be excellent material for use in the silo, in this way utilizing every portion of this crop.

Sugar in Sorghum.

In connection with the subject of the possible sources of a home supply of sugar and syrups, for which New York State annually expends an aggregate of $20,000,000, the following table presenting the results which have been secured during the past five years with several varieties of sorghum, will be of interest. It will be seen that there has been remarkable uniformity in the results, although during each year a different location was chosen upon which to grow the different varieties under investigation.

Sorghums Grown at Geneva Experiment Station.

YEAR.	Number of varieties.	Number of analyses.	Per cent sucrose in juice.	Per cent glucose in juice.
1888	7	10	11.74	1.50
1889	7	13	12.00	1.56
1890	7	36	11.71	....
1891	14	44	11.50	....
1892	13	64	11.65	....

It will be seen, therefore, that for five years in succession there has been grown at the Experiment Station several varieties of sorghum, which, upon analysis, were found to contain a much higher content of sugar than the average quoted above, as found in Louisiana sugar cane, and there would appear, therefore, to be good reason to hope for success in Central New York, where now, for so many years, sorghum has been grown and made into syrups of various degrees of excellence, according to the intelligence and skill of the manufacturer.

The Work of the Station and its Needs.

In order that the necessary demands made upon the Station may be properly met there is need of increased facilities; both men and money are needed to carry forward the work which, perhaps, needs no better evidence of its practical value than is given in the very rapid increase in the number of those who apply for the bulletins which, from time to time, present the results of our investigations in the different lines of agricultural science.

Within five years the Bulletin mailing list has increased from about 500 to 15,000, and not a mail is received which does not add to the number of those who wish for this information. and yet, large as is this number, it means but one Bulletin to every twenty-five of the farmers of the State.

The labor and expense involved in the publication of this large edition is, however, so great, that unless some ample provision shall be made to supply this, it is obvious that the Station can not continue to meet the reasonable demands of the people.

Hundreds of letters from every section of the State could be produced as appreciative evidence of their very great value to the farming community.

The New York State Grange annually appoints as one of the standing committees, three members to visit and report upon the Experiment Station at Geneva, and at the recent annual meeting of the grange this committee made an extended and highly commendatory report of what they learned during an entire day spent in personal inspection of the work of the station. In this report they say :

"Your committee went to Geneva imbued with the idea to determine if the Station, from a financial standpoint, that is, if the Station pays the average, every-day, practical farmer in dollars and cents. We would say, that in our opinion the Station does pay, and pay many, many times over, to the farmers of this State all that it has ever cost or will cost them.

"Your committee can not give a report of all the experiments carried on at the Station, many of which it will take years to determine the value of.

"Your committee would report that all of the experiments are conducted in a practical, accurate and scientific manner, the results of which should be familiar to every member of this order through the Station bulletins published and distributed gratuitously.

"We would earnestly urge all members who are not receiving the bulletins to send their addresses to the Station and request the bulletins sent them.

"One of the many experiments which especially attracted the attention of your committee was the experiment in spraying pear trees for pear scab, and nursery stock for leaf blight, with Bordeaux mixture.

"We saw baskets of Seckel and White Doyenne pears from sprayed and unsprayed trees. The fruit from the sprayed trees was free from scab, fine, smooth and salable. The fruit from the unsprayed trees was very scabby, and hardly fit for market at any time.

"The sprayed nursery stock looked vigorous, and had all of its leaves on, while the unsprayed stock was bare of leaves and had not made near the growth of the sprayed stock.

"This experiment alone will be worth thousands of dollars to the fruit growers of the State if they will pay heed to it.

"The farmers of this State now purchase commercial fertilizers to the amount of four millions of dollars annually, and you can readily see that information on this subject is of vast importance financially.

"Your committee was impressed with the fact that no other line of Station work has resulted in such an actual and present saving of dollars and cents to the farmers of this State as the analysis of commercial fertilizers. It enables the farmer to buy intelligently, and no manufacturers can long do business whose goods do not come up to his analysis when analyzed at the Station. In conclusion let your committee urge all who possibly can to visit the Station and see for themselves, and all to read the bulletins, so as to keep in touch with the work."

It is noteworthy that the above is the official testimony of a committee representing an association of 36,000 farmers distributed through two-thirds of the counties of the State.

His Excellency, the Governor, recently spent the greater portion of a day in careful investigation of each branch of the work of the Station, and has since given repeated testimony to the excellence and practical value to the farmers of the State of the work being carried on at the Station.

It is, of course, highly gratifying to be able to present such testimony as the foregoing, and it would seem a sufficient answer to those who have had no opportunity by personal inspection to confirm such evidence, and yet are in doubt as to whether the Station is in its work and its results rendering to the farmers of the State needed information as to agricultural methods and practice equivalent to its cost of maintenance, and, therefore, deserving their attention and support.

It would seem that there could be no doubt of this so long as ninety per cent of our farmers complain of their calling as no longer profitable, while ten per cent, even in these times, still find farming both pleasant and profitable, and especially when those most prosperous in the pursuit are of those who are availing themselves of the new methods, pursuing the new paths which, to a great extent, our Experiment Stations have marked out.

AMOUNTS EXPENDED FOR SALARIES, LABOR AND EXPENSES.

YEAR.	Salaries.	Labor.	Expenses.	Per cent ratio.		
1890	$8,269 92	$6,010 71	$5,702 71	41.4	30.1	28.5
1891	6,873 70	6,296 31	6,848 29	34.3	34.5	31.2
1892	12,765 88	11,452 77	15,783 82	31.9	28.6	39.5
1893	13,313 22	12,964 20	12,152 06	34.6	33.7	31.7
	$41,222 72	$36,723 99	$40,486 88	34.8	31.0	34.2

From the above it will be seen that the average expenses of the Station for the past four years have been approximately one-third for salaries, one-third for labor and the remaining third for miscellaneous expenses, a good portion of which last includes actual labor performed but not included in the pay-rolls of the Station. This fact will explain the very great amount of work done at the Station, and it is interesting to observe that during the years 1890 and 1891 the regular annual appropriation for the Station was $20,000, while for 1892 and 1893 the appropriation was $40,000 annually.

In this connection it will be seen that, while at this Station during the last four years the relative amounts for salaries and labor have been — salaries 52.9 per cent, labor 47.1 per cent — it has been shown in a previous report that the average amounts for salary and labor in the Experiment Stations of the New England Middle States have been — for salaries 80.6 per cent and for labor 19.4 per cent. New York, therefore, as will be seen, secures a far larger proportionate amount of work for the money expended.

I desire in this connection to express my full appreciation of the zeal, intelligence and faithfulness with which, without exception, so far as my knowledge extends, every one employed at the Station, whether upon the staff of assistants or of the number of laborers, has performed his allotted portion of work, thus rendering the labor not only pleasant, but making it possible, with a force so comparatively small, to have accomplished so much.

Commercial Fertilizers.

During the past year there have been analyzed 330 different brands of fertilizers, the samples of which have been taken by an agent of the Station.

Besides these official samples analyses have been made so far as it has been possible to do so, of unofficial samples sent in by different parties throughout the State, of fertilizers, marls, ashes and so forth, but, owing to the difficulty of securing a fair sample, unless one is informed as to the proper method of procedure, as also owing to the fact that such unofficial samples do not, in case such samples are not found to be up to the guaranteed composition, offer the proper evidence desirable to warrant a prosecution of the parties selling such inferior products, it is very desirable that the work of analysis at the Station should be confined to those samples only collected by our duly appointed and well-instructed agents, through whom it is intended to secure carefully collected specimens of every brand of fertilizer offered for sale in any portion of the State.

Thus far the analyses made continue to show not infrequent failures upon the part of manufacturers and dealers to comply strictly with the requirements of the law, occasionally fertilizers being found for sale containing no guaranteed composition upon the packages as the law directs; many samples also are found where a deficiency in one constituent appears to have been made good in an increase of another beyond the amount guaranteed.

It is hoped that all those knowing of the neglect of manufacturers or dealers to comply with any of the requirements of our fertilizer law will at once give full information of such fact to the Director of this Station, who is charged with the enforcement of the provisions of this excellent law.

The following is a correct copy of the law:

NEW YORK STATE FERTILIZER LAW.

CHAP. 437.

AN ACT for the protection and education of farmers and manufacturers in the purchase and sale of fertilizers.

Approved by the Governor May 24, 1890. Passed, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. All commercial fertilizers which shall be offered for sale, to be used in this State, shall be accompanied by an analysis stating the percentages contained therein of nitrogen or its equivalent ammonia, of soluble and available phosphoric acid, the available phosphoric acid either to be soluble in water or in a neutral solution of citrate of ammonia as determined by the methods agreed upon by the American Society of Agricultural Chemists, and of potash soluble in distilled water. A legible statement of the analysis of the goods shall be printed on, or attached to each package of fertilizer offered for sale for use in the state; and where fertilizers are sold in bulk, to be used in this state, an analysis shall accompany the same, with an affidavit that it is a true representation of the contents of the article or articles.

§ 2. Manufacturers residing in this state, and agents or sellers of fertilizers made by persons residing outside the limits of this state, shall between the *first and twentieth day of July*, in each year, furnish to the Director of the New York State Agricultural Experiment Station at Geneva *a list of the commercial fertilizers they manufacture or offer for sale for use in this State, with the names or brands by which they are known on the market, and the* several *percentages of nitrogen* or its *equivalent of ammonia, of phosphoric acid soluble and available*, and *of potash*, either single or combined, contained in said fertilizer, as called for in section one of this act. Whenever any fertilizer or fertilizing ingredients are shipped or sold in bulk, for use by farmers in this state, a statement must be sent to the Director of the New York state Agricultural Experiment Station at Geneva, giving the name of the goods so shipped, and accompanied with an affidavit from the seller, giving the analysis of such percentage guaranteed.

§ 3. Whenever a correct chemical analysis of any fertilizer offered for sale in this state shall show a deficiency of not more than one-third of one per centum of nitrogen or its equivalent of ammonia, or one-half of one per centum of soluble or available phosphoric acid and one-half of one per centum of potash soluble in distilled water, such statements shall not be deemed false within the meaning of this act. This act shall apply to all articles of fertilizers offered or exposed for sale for use in the state of New York, the selling price of which is ten dollars per ton or higher, and of which they are part or parcel, and of any element into which they enter as fertilizing materials, among which may be enumerated nitrate of soda, sulphate of ammonia, dissolved bone black and bone black undissolved, any phosphate rock, treated or untreated with sulphuric or other acids, ashes from whatever source obtained, potash, salts of all kinds, fish scrap, dried or undried, also all combinations of phosphoric acid, nitrogen or potash, from whatever source obtained, as well as all and every article that is or may be combined for fertilizing purposes.

§ 4. All manufacturers or dealers exposing or offering for sale in this state, fertilizers containing roasted leather or any other form of inert nitrogenous matter shall, in legible print, state the fact on the package in which the fertilizers are exposed or offered for sale.

§ 5. Every person, firm or corporation, violating any of the provisions of this act, shall, upon conviction thereof, for the first offense be punished by a fine of not less than fifty dollars, nor more than two hundred dollars, and for the second offense by double the amount in the discretion of the court; such fines to be paid to the officer whose duty it is to enforce the provisions of this act, to be used by him for that purpose, and to be accounted for to the Comptroller.

§ 6. The Director of the New York State Agricultural Experiment Station at Geneva is charged with the enforcement of the provisions of this act, and shall prosecute in the name of the people, for violation thereof; and for that purpose he may employ agents, counsel, chemists and experts, and the court of special sessions shall have concurrent jurisdiction to hear and determine charges for violating the provisions of this act committed in their respective counties, subject to the power of removal provided in chapter one of title six, of the Code of Criminal Procedure.

§ 7. And the said Director of the New York State Agricultural Experiment Station at Geneva, or his duly authorized agents, shall have full access, egress and ingress to all places of business, factories, building, cars, vessels, or other places where any manufactured fertilizer is sold, offered for sale or manufactured. Such Director shall also have power to open any package, barrel or other thing containing manufactured fertilizer, and may take therefrom sufficient samples; and whenever any such fertilizer is so taken for samples, it may be divided into different portions and one or more portions sealed in such a way that it can not be opened without upon examination giving evidence of having been opened to the person sealing the same, and delivered to the person from whom said sample is taken, or any other person that may be agreed upon, by the said Director or his agents who takes the same and the person from whom it is taken, which portion so delivered may upon consent of the parties be delivered to a chemist for the purpose of being analyzed other than the chemist employed by said Director.

§ 8. The sum of twenty thousand dollars, or so much thereof as may be necessary, is hereby appropriated out of any money in the treasury not otherwise appropriated, to be used by said Director of the New York State Agricultural Experiment Station at Geneva, as shall be authorized by the board of control thereof, in enforcing the provisions of this act. Said sum shall be paid to said Director by the treasurer upon the warrant of the

Comptroller, upon vouchers to be approved by the comptroller, in such sums and at such times as said Director may require, who shall file a statement for what purposes he desires the same.

§ 9. Agents, representatives or sellers of manufactured fertilizers or fertilizing material made or owned by parties outside of this state, and offered for sale for use in this state, shall conform to the provisions of this act, and shall be subject to its penalties, and in all particulars shall take the place of their nonresident principals.

§ 10. Chapter two hundred and twenty-two of the laws of eighteen hundred and seventy-eight is hereby repealed.

§ 11. This act shall take effect immediately.

STATE OF NEW YORK,
Office of the Secretary of State. } ss.:

I have compared the preceding with the original law on file in this office, and do hereby certify that the same is a correct transcript therefrom and of the whole of said original law.

FRANK RICE,
Secretary of State.

The details of these analyses will be found at the close of the chemist's report in this volume. There were made and published 200 analyses of different brands of commercial fertilizers offered for sale in this State in the spring of 1893, and 130 analyses of different brands offered for sale in the fall of 1893.

The average composition of the 200 spring, and of the 130 fall samples is given in the following table:

AVERAGE COMPOSITION OF COMMERCIAL FERTILIZERS.

	Spring.	Fall.	Spring and fall.
Price charged by dealer	$30 15	$27 56	$29 10
Nitrogen, per cent found	2.373	1.480	1.991
Nitrogen, per cent minimum guaranteed	2.278	1.593	2.004
Nitrogen, per cent maximum guaranteed	3.107	2.397	2.823
Avail. phos. acid, per cent found	8.952	9.860	9.310
Avail. phos. acid, per cent minimum guaranteed	8.269	8.771	8.466
Avail. phos. acid, per cent maximum guaranteed	10.235	11.027	10.546
Potash, per cent found	4.055	2.380	3.353
Potash, per cent minimum guaranteed	3.904	2.127	3.183
Potash, per cent maximum guaranteed	5.008	3.104	4.235

In the spring brands analyzed nitrogen was absent in twenty-six and potash in nine samples. In those of the fall brands, nitrogen was absent in fourteen, available phosphoric acid in one and potash in seven samples.

The following table presents the average ratios of the amount of each constituent found to the minimum and maximum amounts guaranteed:

	Nitrogen.	Available phosphoric acid.	Potash.	Average.
Spring minimum guaranteed is: Per cent of that found..............	96	92	96	95
Fall minimum guaranteed is: Per cent of that found	108	89	89	95
Spring and fall minimum guaranteed is: Per cent of that found	101	91	95	96
Spring maximum guaranteed is: Per cent of that found	131	114	124	123
Fall maximum guaranteed is: Per cent of that found	162	112	130	135
Spring and fall minimum guaranteed is: Per cent of that found	142	113	126	127
Spring maximum guaranteed is: Per cent of minimum	136	124	128	129
Fall maximum guaranteed is: Per cent of minimum	150	126	146	141
Spring and fall maximum guaranteed is: Per cent of minimum	141	125	133	133

It will be seen that upon an average the amounts of each constituent found present was only four per cent above the minimum amount guaranteed, while the maximum amount guaranteed averaged 27 per cent more than the amount found, also the maximum guarantee averaged 33 per cent more than the minimum guarantee.

In this connection it is worthy of remark that the results this year show a much nearer average approach in actual content to the minimum amount guaranteed than did the results last year, but the maximum amount *apparently* guaranteed is this year much more in excess of amount found by analysis than it was last year, since then the average excess over the minimum guarantee was 11.8 per cent, while the average maximum guarantee last year was but 17 per cent in excess of amount found, while this year it is 27.

Last year of the 215 samples where minimum and maximnm amounts were given as guaranteed, the average results were as follows:

	Nitrogen, per cent.	Available phosphoric acid, per cent.	Potash, per cent.
Maximum guaranteed	1.984	8.446	3.044
Minimum guaranteed	2.960	10.600	3.980
Found	2.251	9.339	3.371

Or an excess of 13.4 per cent of nitrogen, of 10.6 per cent of available phosphoric acid, and of 10.7 per cent of potash over the minimum amount guaranteed; while the maximum amounts guaranteed were 19.6 per cent of nitrogen, 13.5 per cent of available phosphoric acid and 18 per cent of potash, greater than the actual amount of each of these constituents found to be present.

These facts show the utter absurdity of the system of minimum and maximum guarantees since it is evident that the manufacturers are so well able to control their processes of manufacture as to keep but a narrow margin for safety between the amount for which they are actually liable (that is the *minimum* amount guaranteed) and the amount which analysis shows their products to contain, and yet, although as these facts prove the minimum and maximum guarantee appears to possess some sort of attraction for manufacturers and consumers, since of the 200 brands analyzed in the spring there were only eight which did not have both minimum and maximum guarantees, while of the 130 brands analyzed in the fall there was not one which had a simple guarantee.

So soon as our farmers clearly understand that only the minimum amount is legally binding upon the agent or manufacturer, and that upon an average it very closely represents the amount actually present, while on the other hand the maximum guarantee has no legal force not only, but is practically valueless as indicating the amount actually present, there is reason to believe that the present system of guarantee, which is practically, if not intentionally, misleading will be abandoned.

If in the average analyses found we allow fifteen cents per pound for the nitrogen, which is within one-half a cent of the value of nitrogen in nitrate of soda; six and one-fourth cents a pound for available phosphoric acid, which is the average market value of the soluble and reverted forms, and four and one-half cents per pound for the potash, which is its value in Kainite, we find that the average fertilizer of the 200 spring samples contained in a ton as follows:

47.46 pounds nitrogen, at 15 cents	$7 12
179.04 pounds available phosphoric acid, at 6¼ cents	11 64
81.10 pounds potash at 4½ cents	3 65
Total net value per ton	$22 41

Also, that an average ton of the 130 fall samples contained as follows:

29.60 pounds nitrogen, at 15 cents	$4 44
197.2 pounds available phosphoric acid, at 6¼ cents	12 33
47.6 pounds potash, at 4½ cents	2 14
Total net value per ton	$18 91

The average cost to the farmer of these was for the spring $30.15 per ton, and for the fall $27.56 per ton, a difference of $2.97, but, as we see above, the actual difference in value as determined by composition was $3.50, so that, although costing more per ton, the average spring goods were sold at the lowest price according to real value.

This difference, though small, is worthy of further consideration. The farmers of New York annually expend about $4,000,000 for commercial fertilizers. This sum would buy 132,670 tons at the average spring prices, and 145,138 tons at the average fall prices, and at the calculated values above given the farmers colectively would have obtained for $4,000,000 a value in nitrogen, phosphoric acid and potash as follows:

In spring....	132,670 tons at $22.41 equals.....		$2,973,134 70
In fall	145,138 tons at 18.91 equals.....		2,744,559 58
Difference..	12,468		$228,575 12

In the spring, therefore, although getting 12,468 tons less than they could have bought at fall prices they would have obtained an increased value in fertilizing constituents of $228,575.12, an average saving of 5.7 per cent, or in other words, while the average cost of these fertilizers in the fall was 91 per cent of their cost in the spring, the average value of the fall fertilizers was but 84 per cent of the value in the spring; for by consulting the table given it will be seen that the average nitrogen in the fall fertilizers was but 62 per cent of the average in the spring, and the average potash was but 58 per cent of the amount present in the spring, while there was an average of 10 per cent more available phosphoric acid present in the fall than was present in the spring, the ratio being as 100 for spring to 110 for fall.

A careful study of these matters deserves to be made by the prudent farmer who finds it necessary to increase his home supply of manure by means of these commercial fertilizers.

It appears that it has been the custom of many dealers, especially of those selling ashes, to make sales upon prices subject to the analysis of the Station, and it is obvious that it is practically impossible for the Station to undertake such work, nor is it contemplated by the law that work of such character should be done at the expense of the State. All fertilizers sold or offered for sale within the State at a price of ten dollars or more per ton must be sold upon a guaranteed analysis, and the packages containing such products must have the guaranteed analysis plainly printed upon such packages, but it is not required that these analyses are to be made at the expense of the State, the law requiring only that samples shall, so far as is practicable, be taken of such fertilizing materials, and analysis be made of them to determine whether these products are up to their guaranteed composition within the limits prescribed by law.

The amount of analytical work involved in carrying out the provisions of this law is so great that it is practically impossible to do any work which is unofficial and of the general nature of private work, as analysis of individual samples of fertilizers, of muck, marls, minerals or mineral waters, adulterated foods, suspected cases of poisoning and so forth, except so far as such analyses may partake of a public nature.

Very many samples of soils and feeds also are sent to the Station for analysis, often by those who have little knowledge of the amount of work involved in such analyses, and yet while such analyses are purely of a private character, like the analyses of many of the samples of phosphates, ashes and so forth, sent by individuals from a small lot purchased by them, it was customary to comply with such requests so far as possible until now, when the official work devolving upon the chemists forbids hope that until our chemical force is largely increased such private work, however desirable, can in future receive attention.

Often, however, a very slight examination or simple inspection will suffice to enable a correct conclusion concerning a sample, as of minerals, ores, marls and so forth, and parties are therefore requested to make inquiries concerning such matters, since a letter in reply is often all that is needed. To all such information in possession of the Director or his assistants the public are welcome, but at present anything requiring extended analysis must be put aside.

The Commercial Valuation of Fertilizers.

Owing to the constant application for information concerning this matter it seems best to reproduce practically what has been already said upon this subject, since the Station is almost daily in receipt of letters asking for a money valuation upon a certain fertilizer, the analysis of which is properly guaranteed and upon inspection found to contain the amount of each constituent as guaranteed. The fertilizer law of this State, as will be seen, neither requires such valuation to be made nor does it forbid such valuation, and we have published, from time to time, the scale of prices per pound for each of the constituents in the various forms in which these constituents are found for sale in the leading markets of the country, so that the analysis of any fertilizer being given, it is only necessary to multiply the per cent of each constituent found present by twenty to learn the number of pounds of such constituent present in a ton (2,000 pounds) of the fertilizer, and then to multiply by the prices per pound and add the results together to obtain what may be called the net valuation per ton of such fertilizer.

Two illustrations have been presented in estimating the value of the average commercial fertilizers sold in the spring and in the fall.

But to this net valuation should be added a sum sufficient to defray cost of manufacture of bags or barrels, of freight to consumer, and a reasonable profit, in order to determine what would be a fair price for such fertilizer when delivered to the purchaser and consumer.

The above appears to be a very simple matter but in practice is very difficult to accomplish in a way to do equal justice to manufacturers and consumers, and for the following reasons:

The costs of manufacture and for freight differ greatly, although there appears no good reason why the farmer should pay for the differences which may arise in these ways between the cost of two brands of fertilizers equal in other respects. The main trouble arises from ignorance generally as to the exact form in which the several constituents are present in a certain fertilizer, *e. g.*, whether the nitrogen present is in the form of nitrates, ammonia salts, fish, pomace, horn, leather, hair, or in any other of the many forms in which this element is found in combination.

There can be no question that the chemist is able to fix a perfectly fair valuation upon the nitrogen in either of the above or in other forms, since he has access to the current market quotations for these as for other products, but it is often difficult, if not now and then impossible, at the present, for him to determine the forms in which this element is present in the product under analysis.

While, therefore, it is easy upon analysis of any given fertilizer to calculate the minimum valuation commercially of the constituents present, such valuation would, in the great majority of cases, be obviously unfair to the manufacturer, but it is equally obvious that the manufacturer has it in his power to secure full justice to himself in this matter of valuation if he will, and in the following way: at present, the law, while permitting the sale of anything which may be placed upon the market as a fertilizer, trusting to the general intelligence of the purchaser to protect him from what is worthless, it specially provides that in case leather or other inert forms of nitrogen compounds are used as a constituent of any fertilizer, such fact must be declared by the manufacturer using such material.

It will be observed that there is no restriction upon the sale of leather or other inert forms of nitrogenous matter, nor upon the price which may be demanded for the same, and it would appear that without in any way attempting to limit the sale or control the prices of the other constituents used in the manufacture of commercial fertilizers, it might be reasonably demanded that those offering such products for sale in the State should be compelled to state the character and constituents of their several products, since it is notoriously true that of the several nitrogenous compounds present in fertilizers the nitrogen in some is as fairly worth seventeen cents per pound as it is in another form worth seven cents per pound, or in certain other forms scarcely worth one cent per pound.

What is true in nitrogen is somewhat true in the case of phosphoric acid and potash, but not to an equal degree; but there exists a widespread preference upon the part of the farmers for soluble and available phosphoric acid derived from bone rather than from South Carolina or other mineral phosphates, as is evidenced by the very common practice of fertilizer manufacturers to calculate the phosphoric acid in their product as equivalent to so much bone-phosphate, often in cases where all of it is obtained from other phosphates than bone.

The objection often, and perhaps always, made to the suggestion that the source of the several constituents should be stated by the manufacturers of fertilizers, is that unscrupulous persons would not hesitate to state that the best raw materials were used in their products, and such objection is perhaps likely for a time to prove true, but there can be little doubt that in the end the honest manufacturers will find, as is ever the case, that established reputation for integrity and fair-dealing is quite as valuable in their business as in any other, and besides it would prove a comparatively easy matter to trace to their destination suspected material, and to devise speedy methods by which its character could be detected in the manufactured products, even if such means are not already in the hands of the analytical chemist. At least it seems that less injustice would result from the plan suggested than now, when, as will be seen by looking over the published analyses, two fertilizers have the same guaranteed and found analyses, and are presumptively therefore of equal value, when if the character of the several compounds from which they are made was known, great differences in their commercial and crop-producing values might clearly appear.

Certain agricultural authorities are quite opposed to any system of commercial valuation of fertilizers, and in opposing declare themselves to do so mainly, if not wholly, in the interests of the farmers. They say that an unfortunate tendency of money valuations is to call the attention of the farmers away from the composition of the fertilizer, and to direct it to a standard which is often of doubtful accuracy, if not positively wrong; and that as a result not only does the farmer get wrong impressions in place of right ones, but honest dealers are harassed, and sometimes pecuniarily injured, by incorrect valuation of their wares. The above is somewhat obscure without the statement as to what constitutes a correct standard, and what are considered to be the wrong impressions of which the farmer is in danger.

Again, it is asserted by such authorities that our farmers not only intend to buy a certain number of pounds of plant food in their purchases of fertilizers, but they intend to buy that plant food in forms that will be available to the plant.

This last is beyond question true, certainly of the more intelligent class of our farmers, and it should be true of all, but if true, it is difficult to imagine how such farmers, with so clear an idea of what they want, can be diverted from such dominant idea by the simple consideration as to what dealer will supply his demand at the least cost. It will appear as easy to sell a farmer salt instead of sugar, simply because the former was the cheaper.

Again it is clear that so long as the manufacturers of fertilizers decline to assure the purchaser as to the character of the goods they have for sale, and in effect this is the position of the trade in mixed commercial fertilizers at the present time, it is practically impossible for the farmers to carry out the intelligent ideas attributed to them concerning the kind of fertilizer and the forms in which it is offered them.

Certain manufactures of mixed fertilizers are also dealers in the various chemicals used for fertilizing, as nitrate of soda, sulphate of ammonia, muriate and sulphate of potash of different grades of purity, dried blood, acid phosphate, etc., etc., and they furnish to the would-be purchaser the exact composition of their products, and the purchaser is thus enabled to buy exactly what he wants both as to quality and quantity. Since this branch of the business has been conducted now for over a quarter of a century, it has been found presumably a profitable matter of trade, but it seems strange that these same manufacturers, when offering for sale a mixed fertilizer, are unwilling to inform their customers concerning the materials entering into their products, and it seems stranger still that the farmers are willing to continue to buy these goods, concerning which they cannot have such knowledge as is indispensable to an intelligent use of commercial fertilizers.

The reply generally made by the manufacturers to what appears a desirable change in the present method is that dishonest dealers would have their products overestimated in value, since they would not scruple to assert that their fertilizers were made up from the best materials, and while this would doubtless be true for a time, still it is obvious that the same objection would lie against any other industry, but our best shop-keepers do not hesitate to pronounce goods to be silk, wool or linen, as the case may be, relying upon the fact that their customers will learn sooner or later that their statements may be relied upon, and such a reputation is not only of great value, but the sure reward of those who are just and trustworthy in their dealings.

There is, however, very little danger that the fertilizer manufacturer is likely to suffer materially by any money valuation of his products, since, as will be seen, the danger lies in another direction, viz., that, while the best are valued at approximately their true worth, comparatively inferior products are valued more highly than they should be owing mainly to the present partial inability of chemists to determine certain nitrogen containing products, which it is generally believed are employed by certain parties. However, it by no means follows that a good dollar is worth more because worthless counterfeits have often been passed in their place.

If we take the average composition of the 330 fertilizers analyzed we shall find that it was as follows, each ton containing 1.991 per cent of nitrogen, or 39.82 pounds; 9.310 per cent of available phosphoric acid, or 186.20 pounds; 3.353 per cent of potash, or 67.06 pounds.

Each year a company of leading chemists, officially charged with the chemical inspection of commercial fertilizers sold in their respective States, meet and adjust a scale of prices for the several valuable fertilizing constituents.

These prices fixed upon by this body are simply the prices which they find these several constituents have in the leading markets, and their method is entirely in accord with that by which the prices in our markets of the several farm products, as corn, wheat or potatoes are secured, or the published quotations of the stock exchange.

The following is the list of prices adopted by this body of men for the preceeding and current year:

TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS, ADOPTED BY EXPERIMENT STATIONS.

	1892. Cts. per pound.	1893. Cts. per pound.
Nitrogen in ammonia salts	17½	17
Nitrogen in nitrates	15	15½
Organic nitrogen in dry and fine ground fish, meat and blood, and in high grade mixed fertilizers	16	17½
Organic nitrogen in cotton-seed meal and castor-pomace	15	16½
Organic nitrogen in fine ground bone and tankage,	15	15
Organic nitrogen in fine ground medium bone and tankage	12	12
Organic nitrogen in medium bone and tankage	9½	9
Organic nitrogen in coarse bone and tankage	7½	7
Organic nitrogen in hair, horn shavings and coarse fish scraps	7	7

	1892. Cts. per pound.	1893. Cts. per pound.
Phosphoric acid, soluble in water	7½	6½
Phosphoric acid, soluble in ammonium citrate	7½	6
Phosphoric acid, in fine bone and tankage	7	6
Phosphoric acid, in fine medium bone and tankage,	5½	5
Phosphoric acid in medium bone and tankage	4½	4
Phosphoric acid in coarse bone and tankage	3	3
Phosphoric acid in fine ground fish, cotton seed meal, castor-pomace and wood ashes	5	5
Phosphoric acid in fine ground rock phosphate	2	2
Potash as high-grade sulphate in forms free from muriates (chlorides) in ashes, etc	5½	5½
Potash in kainit	4½	4½
Potash in muriate	4½	4½
Organic nitrogen in mixed fertilizers	17	17½
Insoluble phosphoric acid in mixed fertilizers	2	2

VALUATION OF FERTILIZING INGREDIENTS IN FOODS.

Organic nitrogen	——	17½
Phosphoric acid	——	5
Potash	——	5½

It is obvious that no one can object to this scale on the ground of its absolute fairness, since it is only upon information obtained from dealers and manufacturers upon which the whole scale is based; but the objection made is to the application of this scale to any given fertilizer.

Let us estimate the extent of the injustice which is possible, but hardly probable in such application.

If we estimate in our average fertilizer the nitrogen, available phosphoric acid and potash at fifteen cents, six and a quarter cents and four and a half cents per pound, respectively, we have the following:

39.82 pounds of nitrogen at 15 cents	$5 97
186.20 pounds of available phosphoric acid at 6¼ cents	11 64
67.06 pounds of potash at 4½ cents	3 03
Value per ton	$20 64

The only objection, if any, which can be made to the above is that the nitrogen is estimated at too low a price, but as will be seen by the scale it is within one half a cent per pound of the price at which it can be obtained in nitrate of soda. The phosphoric acid is estimated within a quarter of a cent per pound of its highest market value, and the potash at its value in muriate.

Now if we grant that the nitrogen is worth more than our estimate, and the chances are very great that the error is the other way, yet supposing we adopt the very highest price, viz.: that which it is worth in ammonia salts, and probably not one-half of one per cent of the nitrogen present in our mixed fertilizers is in this most valuable condition, still even at seventeen cents per pound for the nitrogen we would have underestimated this average ton at eighty cents less than its value, and the ton would have been worth $21.44 instead of $20.64, but this difference on eighty cents would have been an error in the correct valuation of only 3.7 per cent of the total value of the fertilizer.

It will be seen therefore that the honest manufacturers have really no great grievance to complain of, and it certainly may be questioned whether they have just cause to complain at all in view of the fact that they have it quite in their power to enable those charged with this legal inspection of these products, to place upon them an absolutely correct estimate, even at the risk of too high a valuation being temporarily placed upon the products of those who may not hesitate to misrepresent the composition of their wares.

In view of the numerous items of expense which inevitably attend the putting of these goods upon the local markets of the State, such as expense of manufacture, bagging, freight, interest, and not frequently bad debts, there is no reason to suppose that unusually large profits upon an average attend this business, but as has been shown, there is a very considerable difference between the actual market value of what the farmers get upon an average for their money and the prices they pay, the average value of the 330 fertilizers analyzed being $20.64, while their average cost to the farmers was $29.10, a difference per ton of $8.46 or 41 per cent.

If now the farmer should desire he can easily obtain the materials in the market which by mixing together will give him a fertilizer in which he may know exactly not only what per cent of each fertilizing constituent is present, but in what forms of combination each constituent exists.

For example let us suppose the farmer desires a fertilizer which shall exactly correspond in composition with the average of the 330 analyzed, *i. e.*, containing 1.991 per cent nitrogen, 9.31 per cent available phosphoric acid and 3.353 per cent of potash; and let us assume that he desires a third of the nitrogen to be in the form of nitrate of soda, a third of sulphate of ammonia and a third as dried blood, also that the potash shall be in the form of muriate.

An average composition of the above as found in the market is as follows:

	Per cent.
Nitrate of soda contains, of nitrogen	16.47
Sulphate of ammonia contains, of nitrogen	20.50
Dried blood contains, of nitrogen	10.52
Dissolved bone black contains, of available phosphoric acid	16.70
Kainite contains, of potash	13.54

As we have seen, his fertilizer is to contain in each ton 39.82 pounds of nitrogen, 186.2 pounds of available phosphoric acid and 67.06 pounds of potash, and as one third of the nitrogen is to be in each of the above mentioned forms it is only necessary to divide the required pounds of each constituent by the percentage of this constituent present in the material to furnish it, and we would have the following result:

Pounds.		Per cent.		Pounds.
1115.	Dissolved bone black at	16.7	Phos. acid	186.2
127.8	Muriate of potash at	52.46	Potash	67.2
126.2	Dried blood at	10.52	Nitrogen	13.28
64.8	Sulphate of ammonia at	20.50	Nitrogen	13.28
80.6	Nitrate of soda at	16.47	Nitrogen	13.28
1514.4				

Now to this may be added 485.6 pounds of gypsum and we would have 2,000 pounds of the mixture of the required composition.

It will be observed in this mixture there are in all but 14.65 per cent of nitrogen, phosphoric acid and potash, and not infrequently the suspicion arises that the remaining 85.35 per cent is used by the manufacturer in the nature of a filler, but if we examine the material which we have used in the preparation of this fertilizer we shall see that this is an erroneous view and very unjust to the manufacturer, for to secure our needed amounts of nitrogen, potash and phosphoric acid we used as follows:

Pounds.		Pounds.	
64.8	Sulphate of ammonia containing only	13.3	Nitrogen.
80.6	Nitrate of soda containing only....	13.3	Nitrogen.
126.2	Dried blood containing only	13.3	Nitrogen.
127.8	Muriate of potash containing only .	67.1	Potash.
1115.0	Dissolved bone black contain'g only	186.2	Phos. acid.
1514.4		293.2	
485.6	Plaster or gypsum.		
2000.0			

To obtain, therefore, the desired amounts of these three fertilizing constituents we have had to introduce 1221.2 pounds, about eighty-one per cent of other matter. The plaster added to make up the round ton might properly be regarded as a filler.

In the preparation of superphosphate of lime from bone ash, two-thirds of the lime combined with the phosphoric acid is taken away by the sulphuric acid which is added to the bone ash, and the sulphuric acid and lime unite to form sulphate lime or plaster or gypsum.

In a complete reaction 138 parts by weight of bone ash ninety-eighty parts of sulphuric acid would form 117 parts by weight of superphosphate of lime and 120 parts of sulphate of lime, but this 117 parts of superphosphate would contain seventy-one parts of sulphuric acid, so, as will be seen, in order to get this seventy-one parts of phosphoric acid it is necessary to have present with it at least 166 parts of other material, equal to 70 per cent of the mixture.

By a similar calculation to the preceding it is an easy matter to compound a mixed fertilizer having any desired composition and composed of such materials as the farmer may desire.

With an increase of intelligence among our farmers concerning the use of these products, and with the growing necessity of economy in their expenditures, it would seem the wisest plan for the manufacturers and dealers in mixed fertilizers to take the initiative by fully presenting to the farmer every item of information concerning the composition of these fertilizers, which it is important for the farmer to know since, unless such course shall soon be entered upon, there is every reason to believe that the number, now large, of our farmers who prepare their own fertilizers from the chemicals and raw material purchased in open market will in the near future so greatly increase as to practically do away with the manufacture of mixed fertilizers as at present conducted, and while even now granges, farmers' clubs and other bodies of farmers in many sections are uniting in their purchases of mixed fertilizers through motives of economy, they will soon unite through increasing intelligence in the preparation of fertilizers from formulas of their own, and from the materials of which they desire that such fertilizers shall be composed.

Names of Manufacturers Offering Fertilizers for Sale in The State During 1893.

Acme Fertilizer Co., Maspeth, L. I.
Allentown Manufacturing Co., Allentown, Penn.
Armour & Co., Chicago, Ill.
H. J. Baker & Brother, 215 Pearl street, New York, N. Y.
Baltimore Guano Co., Canton, Md.
Bowker Fertilizer Co., 43 Chatham street, Boston, Mass.
Bradley Fertilizer Co., Boston, Mass.
Brown & Gilman, 10 S. Delaware avenue, Philadelphia, Penn.
E. B. Chapin, Rochester, N. Y.
Chemical Company of Canton, Baltimore, Md.
Chesapeake Guano Co., Baltimore, Md.
Clark's Cove Fertilizer Co., 81 Fulton street, New York, N. Y.
Cleveland Dryer Co., Cleveland, O.

E. Frank Coe, 16 Burling Slip, New York, N. Y.
Peter Cooper's Glue Factory, 17 Burling Slip, New York, N. Y.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.
E. A. Cross, North Parma, N. Y.
Cumberland Bone Phosphate Co., Cumberland, Me.
Danbury Fertilizer Co., Danbury, Conn.
L. B. Darling Fertilizer Co., Pawtucket, R. I.
J. H. Devins, Utica, N. Y.
L. Eggers' Sons, Novelty Bone Works, West Troy, N. Y.
Ellsworth Tuthill & Co., Promised Land, Suffolk Co., N. Y.
W. S. Farmer & Co., Baltimore, Md.
Farmers' Fertilizer Co., Syracuse, N. Y.
George B. Forrester, 169 Front street, New York, N. Y.
Great Eastern Fertilizer Co., Rutland, Vt.
Hallock & Duryea Fertilizer Co., Mattituck, Suffolk Co., N. Y.
Isaac C. Hendrickson, Jamaica, Queens Co., N. Y.
S. M. Hess & Brother, Philadelphia, Penn.
Hubbard & Co., 10 Light street, Baltimore, Md.
Imperial Guano Co., Norfolk, Va.
Lackawanna Fertilizing Co., Moosic, Penn.
Liebig Manufacturing Co., Carteret, N. J.
Listers' Agricultural Chemical Works, Newark, N. J.
Lorentz & Rittler, Baltimore, Md.
Frederick Ludlam, 108 Water street, New York, N. Y.
Mapes Formula and Peruvian Guano Co., 143 Liberty street, New York, N. Y.
Maryland Fertilizer and Manufacturing Co., 30 S. Holliday street, Baltimore, Md.
Michigan Carbon Works, Detroit, Mich.
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.
Mitchell Fertilizer Co., Tremley, N. J.
L. Mittenmaier, Rome, N. Y.
Moller & Co., Bone Works, Maspeth, Queens Co., N. Y.
Moro Phillips Chemical Co., 131 S. Third street, Philadelphia, Penn.
Henry E. Myers, Middletown, N. Y.
National Fertilizer Co., Bridgeport, Conn.
Newark Chemical Co., Newark, N. J.

Northwestern Fertilizing Co., Union Stock Yards, Chicago, Ill.
Oakfield Fertilizer Co., Oakfield, N. Y.
Oneonta Fertilizer Co., Oneonta, N. Y.
Pacific Guano Co., Boston, Mass.
J. E. Phelps, Jamaica, N. Y.
Pottstown Iron Co., Pottstown, Penn.
Preston Fertilizer Co., Green Point, Kings Co., N. Y.
The Quinnipiac Co., 83 Fulton street, New York, N. Y.
John Ralston, 16 Burling Slip, New York, N. Y.
Rasin Fertilizer Co., Baltimore, Md.
Read Fertilizer Co., New York, N. Y.
John S. Reese & Co., Baltimore, Md.
Rochester Fertilizer Co., 393 East Main street, Rochester, N. Y.
Rogers & Hubbard Co., Middletown, Conn.
Samson Fertilizer and Chemical Co., North East, Penn.
Lucien Sanderson, New Haven, Conn.
Schaal Brothers, Erie, Penn.
Scott Fertilizer Co., Elkton, Md.
Sheldon Brothers, Weedsport, N. Y.
Springfield Fertilizer Co., Springfield, O.
Standard Fertilizer Co., Boston, Mass.
H. Stappenbeck, Utica, N. Y.
Sterling Oil Co., Greenport, Suffolk Co., N. Y.
W. D. Stewart, 7 Exchange place, Boston, Mass.
Richard H. Stone, Trumansburgh, N. Y.
F. E. Sturtevant, Hartford, Conn.
Swift & Co., Chicago, Ill.
I. P. Thomas & Son Co., 2 S. Delaware avenue, Philadelphia, Penn.
George F. Tuthill & Co., Greenport, Suffolk Co., N. Y.
The Tygert-Allen Fertilizer Co., 2 Chestnut street, Philadelphia, Penn.
J. E. Tygert & Co., 42 S. Delaware street, Philadelphia, Penn.
Walker Fertilizer Co., Clifton Springs, N. Y.
Walker, Stratman & Co., Pittsburgh, Penn.
Walker, Wann & Co., Wilmington, Del.
Williams & Clark, 81 Fulton street, New York, N. Y.
Zell Guano Co., Baltimore, Md.

Commercial Fertilizers Sold in New York State.

During the last two years an effort has been made to determine the aggregate sales of the different kinds of fertilizing materials annually sold in this State. A circular letter was addressed to the various manufacturers doing business in this State, requesting information as to the aggregate of their sales, and also the quality of the fertilizers sold, in order that information might be obtained as to the relative consumption of phosphoric acid, potash and nitrogen compounds. It is not intended, of course, to make public the details of individual business, but to secure such general information concerning this trade as would appear to be of value to both manufacturers and consumers of these products.

In the main the manufacturers thus addressed have promptly responded to the circular asking for this information. In several cases no replies have been received, while in a few cases a fear has been expressed lest the information thus given might transpire.

To allay any such fear in the future, and in order that no information given in this report can be manipulated in such a way as to enable one manufacturer to approximately estimate the sales of another, it is thought best not to indicate in any way those manufacturers who have not reported, and to assure those who have done so, that so soon as the sales received from them have been tabulated, every report has been burned so that there does not now exist in possession of the Station any information other than that embodied in the following statement:

Aggregate Amounts of Fertilizers Reported as Sold in this State During the Year Ending November 1, 1893.

	Tons.
Complete manuring for spring use	59,578.75
Complete manuring for fall use	28,950.15
Ammoniated superphosphates without potash, including dissolved bone, etc., for spring use	544.56
Ammoniated superphosphates without potash including dissolved bone, etc., for fall use	425.50

	Tons.
Ground bone for spring use	2,154.18
Ground bone for fall use	1,396.18
Kainit, for spring use	602.05
Kainit, for fall use	283.35
Muriate and sulphate of potash, for spring use	497.22
Muriate and sulphate of potash, for fall use	240.13
Nitrogenous matter:	
(a) Ammonium sulphate, for spring use	172.90
Ammonium sulphate, for fall use	55.14
(b) Sodium nitrate, for spring use	127.48
Sodium nitrate, for fall use	37.72
(c) Blood, ammonite, etc., for spring use	4,081.00
Blood, ammonite, etc., for fall use	3,951.75
Plain superphosphates, including both dissolved bone black and S. C. acid phosphates for spring use	1,652.64
Plain superphosphates, including both dissolved bone black and S. C. acid phosphates for fall use,	1,443.02
Odorless phosphate	326.98
Total	106,520.70

Newspapers and Periodicals Presented to the Station.

Agricultural Epitomist, Indianapolis, Ind.
Albany Weekly Journal, Albany, N. Y.
Allegan Gazette, Allegan, Mich.
American Agriculturist, New York, N. Y.
American Cultivator, Boston, Mass.
American Dairyman, New York, N. Y.
American Grange Bulletin, Cincinnati, Ohio.
American Grocer, New York, N. Y.
American Stock-Keeper, Boston, Mass.
Baltimore Weekly Sun, Baltimore, Md.
Canadian Entomologist, Fort Hope, Canada.
Canadian Horticulturist, Grimsby, Ontario, Canada.
Chautauqua Farmer, Dunkirk, N. Y.
Clover Leaf, South Bend, Ind.

Cultivator and County Gentleman, Albany, N. Y.
Detroit Free Press, Detroit, Mich.
Every Week, Angelica, N. Y.
Farmers' Advocate, London, Canada.
Farm and Fireside, Philadelphia, Penn.
Farm and Home, Springfield, Mass.
Farmers' Home, Dayton, Ohio.
Farm Journal, Philadelphia, Penn.
Farm Life, Rochester, N. Y.
Farm, Stock and Home, Minneapolis, Minn.
Gardening, Chicago, Ill.
German Agricultural and Horticultural Journal, New York, N. Y.
Grange Visitor, Lansing, Mich.
Hoard's Dairyman, Fort Atkinson, Wis.
Holstein-Friesian Register, Boston, Mass.
Horticultural Art Journal, Rochester, N. Y.
Husbandman, Binghamton, N. Y.
Jersey Bulletin, Indianapolis, Ind.
Ladies' Home Companion, Philadelphia, Penn.
Louisiana Planter and Sugar Manufacturer, New Orleans, La.
Maritime Agriculturist, St. John, N. B.
Maryland Farmer, Baltimore, Md.
Mirrow and Farmer, Manchester, N. H.
Monthly Weather Review, Washington, D. C.
National Nurseyman, Rochester, N. Y.
Nebraska Bee-Keeper, York, Neb.
Nebraska Farmer, Lincoln, Neb.
New England Farmer, Boston, Mass.
Northwestern Farmer, St. Paul, Minn.
Orange County Farmer, Port Jervis, N. Y.
Orange Judd Farmer, Chicago, Ill.
Orchard and Garden, Little Silver, N. J.
Peninsular Farmer, Federalsburg, Md.
Pharmaceutical Era, Detroit, Mich.
Planters' Monthly, Honolulu, H. I.
Poultry Monthly, Albany, N. Y.
Practical Farmer, Philadelphia, Penn.
Rural New Yorker, New York, N. Y.

Southern Cultivator, Atlanta, Ga.
Stock and Farm, Bunker Hill, Ind.
Sugar Beet, Philadelphia, Penn.
Sugar Bowl and Farm Journal, New Orleans, La.
Vick's Illustrated Monthly Magazine, Rochester, N. Y.
Western Plowman, Moline, Ill.
World, New York, N. Y.

Gifts to the Station.

APPLE.

April 12. S. Richardson, Richardson, Utah. Richards.

April 20. Josiah G. Youngken, Richlandtown, Penn., Cions of New Water, Barnes' Choice and Sigfried.

APRICOT.

April 12. S. Richardson, Richardson, Utah, two Uvadale.

BLACKBERRY.

April 7. Frank Ford & Son, Ravenna, O., three Ford's No. 1.

April 14. Albaugh Nursery Co., Tadmor, O., three Ohmer and six Black Chief.

April 18. J. M. Mersereau, Cayuga, N. Y., six plants unnamed seedling.

April 19. Ellwanger & Barry, Rochester, N. Y., two Early King.

CARROT.

May 5. Northrup, Braslan & Goodwin Co., Minneapolis, Minn., one package each of Victoria and Mastodon.

CELERY.

April 23. R. & J. Farquhar & Co., Boston, Mass., one packet Carter's Dwarf Crimson.

CHERRY.

April 5. Joseph H. Black & Son, Hightstown, N. J., one Mercer.

April 12. W. F. Heikes, Huntsville, Ala., two each of Esel Kirsche and Early Lamaurie.

April 20. Josiah G. Youngken, Richlandtown, Penn., cions of Vail's August Duke.

April 21. Ellwanger & Barry, Rochester, N. Y., two Windsor.

April 30. Storrs & Harrison Co., Painesville, O., one Rocky Mountain.

May 11. George A. Sweet, Dansville, N. Y., two Schmidt's Bigarreau.

CLOVER.

March 10. Earl R. Potter, Leeds, N. Y., one package of hop vine clover.

CORN.

May 5. Northrup, Braslan & Goodwin Co., Minneapolis, Minn., one ear each of Minnesota King and Zigzag Evergreen.

CURRANT.

April 1. R. H. Blair & Co., Kansas City, Mo., six Jelly.

April 12. S. Richardson, Richardson, Utah, two Utah Golden.

April 13. Charles Mills, Fairmount, N. Y., Nos. 22, 28 and 29 Mills.

April 17. Jacob Moore, Attica, N. Y., six plants of No. 23.

November 14. John Charlton, Rochester, N. Y., six plants White Versailles.

FERTILIZER.

October 4. Walker Fertilizer Co., Clifton Springs, N. Y., one ton.

GLADIOLUS.

April 7. D. S. Marvin, Watertown, N. Y., six dozen.

GOOSEBERRY.

March 29. Joseph T. Thompson, Oneida, N. Y., seedling of Columbus-yellow.

April 14. Albaugh Nursery Co., Tadmor, O., six Champion and six Excelsior.

GRAPE.

January 9. O. Everts, Jordan, Onondaga county, N. Y., grape cuttings.

March 29. J. T. Thompson, Oneida, N. Y., grape cuttings, No. 5 and No. 7.

April 18. Joseph Hart, Fayetteville, Ark., two Arkansaw.

April 20. P. Henderson & Co., 35 Cortland street, New York, N. Y., two each Trask, Randall and Roenbeck.

April 21. Ellwanger & Barry, Rochester, N. Y., Creveling, Poughkeepsie Red, Herbert, Canada, Rebecca, Telegraph, Massasoit and Diana.

April 21. W. B. Brown, 177 Water street, Newburgh, N. Y., Brown's seedling and a White seedling.

April 28. Stayman & Black, Leavenworth, Kans., Cochel, Eclipse, Leavenworth, Magnate, Mendota, Omega, Osage, Ozark, Paragon, Perfection, Pulaski, White Imperial.

May 16. D. G. Edmeston, Adrian, Mich., Edmeston No. 1.

MUSKMELON.

March 11. U. S. Department of Agriculture, Washington, D. C., three packets Ispahan.

MYRICA RUBRA.

April 8. P. J. Berckmans, Augusta, Ga., Myrica rubra (Japan Mountain peach).

NOZZLE.

April 4. J. J. McGowan, Forest Home, N. Y., one McGowan nozzle.

PAWPAW.

March 4. A. J. Knisely, Benton Harbor, twelve pawpaw.

PEA.

April 19. S. J. Smith, Manchester, N. Y., one package of No. 40.

PEACH.

March 22. Chase Brothers & Co., Rochester, N. Y., two trees each, Ostrander Early and Ostrander Late.

April 12. S. Richardson, Richardson, Utah, two trees each of Stewart's No. 1 and Stewart's No. 2.

PEAR.

April 12. W. F. Heikes, Huntsville, Ala., two Winter Bartlett.

April 20. Josiah G. Youngken, Richlandtown, Penn., Ellis.

April 26. L. W. Carr, Erie, Penn., two dwarf Centennial.

PLUM.

January 23. Luther Burbank, Santa Rosa, Cal., cions of Long Leaf Wonderful Prune, Round Leaf Wonderful Prune, Golden and J.

April 17. M. E. Hinkley, Marcus, Iowa, one each of Marcus and Pilot.

April 20. Josiah G. Youngken, Richlandtown, Penn., cions of Hughes, Tobias and Smiley.

May 11. George A. Sweet, Dansville, N. Y., two each Diamond and Spaulding.

POTATO.

March 25. F. B. Van Ornan, Lewis, Iowa, one tuber of Van Ornan's Superb.

March 29. R. Johnston, Shortsville, N. Y., Reed's Seedling and Kent.

April 17. R. C. Barless, Rose, N. Y., five tubers of Early May.

April 20, S. J. Smith, Manchester, N. Y., Early Six Weeks.

June 27. J. C. Vaughn, Chicago, Ill., one-half peck World's Fair.

PUMP.

February 9. F. E. Myers & Brother, Ashland, O., one bucket spray pump.

QUINCE.

January 23. Luther Burbank, Santa Rosa, Cal., Van Deman and Santa Rosa.

RASPBERRY.

April 14. Albaugh Nursery Co., Tadmor, O., six Haynes seedling unnamed blackcap.

April 15. A. H. Griesa, Lawrence, Kan., twenty-four Kansas.

April 17. W. N. Scarff, New Carlisle, O., three Fruitland and six Eureka.

April 18. C. H. Manwaring, Lawrence, Kan., Manwaring No. 1.

April 21. Ellwanger & Barry, Rochester, N. Y., six Superlative.

April 6. G. W. Cline, Winona, Ont., six Cline.

STRAWBERRY.

March 29. Dayton Star Nurseries, Dayton, O., twelve Shuckless.

April 6. Jackson & Perkins, Newark, N. Y., twenty-five plants each Eureka, Rush and Number One.

April 10. Charles H. Sumner, Sterling, Ill., twelve Splendid.

April 15. A. Sanders, Sac City, Iowa, Sanders' Success.

April 18. Edward T. Ingram, West Chester, Penn., twenty-five Brandywine.

April 21. E. A. Riehl, Alton, Ill., fifteen plants of Riehl's Nos. 5 and 6.

April 25. E. W. Cruse, Leavenworth, Kan., twelve plants each, Cyclone No. 9, Cruse and Aroma.

April 26. E. W. Reid, Bridgeport, O., eight Timbrell.

April 27, H. S. & A. J. See, Geneva, Penn., thirty each of See's Nos. 1 and 2.

May 1. A. Luther, Leeds, Mo., twenty-five plants unnamed.

May 10. G. W. Cline, Winona, Canada, twenty-five Random.

May 10. F. L. Ray, E. Clarridon, O., twelve Wilson, Jr.

May 13. George Townsend, Gordon, O., twenty-six plants Townsend No. 30.

May 13. W. F. Allen, Jr., Salisbury, Md., twenty-five plants each Nos. 5, 6, 13 and 14.

May 13. West Jersey Nursery Co., Bridgeton, N. J., twelve plants Columbia.

July 22. Slaymaker & Son., Dover, Del., twelve plants Aldridge No. 25.

TOMATO.

January 19. A. M. Nichol, Granville, O., one packet Nichol's No. 5.

February 6. E. J. Hull, Olyphant, Penn., Ignotum seed.

March 27. C. S. Bond, Worthington, Minn., one packet Bond's Early Minnesota.

VEGETABLE SEEDS.

January 24. J. M. Thorburn & Co., New York, N. Y., nine packets.

January 27. W. A. Burpee & Co., Philadelphia, Penn., thirty packets.

March 25. Peter Henderson & Co., 35 Cortland street, New York, N. Y., a collection.

May 12. F. Barteldes, Lawrence, Kan., five packets.

May 12. J. C. Vaughan, Chicago, Ill., four packets.

VINE HOLDERS.

March 1. Rochester Radiator Co., Rochester, N. Y., one packet.

WILLOW.

March 10. Charles E. Pennock, Fort Collins, Col., cuttings.

April 11. U. S. Department of Agriculture, Washington. D. C., two packages each of Salix Uralensis serotina and Salix amygdalina canescens.

REPORT OF FIRST ASSISTANT.*

The work in charge of the first assistant during the year 1893 has been similar to that of the preceding year. Considerable time has been spent in attending to part of the very large amount of incidental and routine work connected with the general station management. During the first few months of the year a great deal of time was given to the preparation and arrangement of exhibits intended for the Chicago exposition.

Cattle feeding.

The feeding of the dairy cattle under experiment has been attended to and the rations for them arranged. The hay or forage at different months of the year most readily obtainable was supplemented by different grain foods. The coarse foods used during the year were: mixed hay, largely timothy, mixed hay of red top and clover, mixed hay of timothy and alsike clover, clover hay, corn silage, rye forage, alfalfa forage, oat and pea forage, corn forage, sorghum forage and beets. The grain foods were: wheat bran, corn meal, gluten feed, wheat middlings, ground oats, cottonseed meal, linseed meal (old process and new process), and ground flaxseed. The amounts and proportions of the different foods were varied somewhat according to the condition, appetite and age, but cows in approximately the same stage of lactation were fed as nearly alike as possible.

The milch cows during January were fed mixed hay (mostly timothy, some clover) morning and night, corn silage at noon, and at morning and night a mixed grain consisting of five parts wheat bran, four parts linseed meal (N. P.), one part wheat middlings, one part ground oats, one part cottonseed meal.

During February and March mixed hay (mostly timothy, some alsike clover) was fed morning and night, corn silage at noon, and at morning and night a mixed grain consisting of five parts wheat bran, three parts cottonseed meal, one part linseed meal (O. P.), and one part wheat middlings.

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*William P. Wheeler.

For April and May corn silage was fed in the morning and at noon and clover hay at night. The mixed grain fed morning and night consisted of six parts wheat bran, two parts wheat middlings, two parts corn meal, one part cottonseed meal, one part linseed meal (O. P.), and one part ground oats.

For the first ten days in June alfalfa forage was fed in the morning, rye forage at noon and mixed hay (red top, clover, etc.) at night. For the rest of the month alfalfa forage was fed morning and noon and hay at night. The mixed grain fed throughout the month, morning and night was composed of five parts wheat bran, four parts corn meal, one part ground oats, one part wheat middlings, one part linseed meal (N. P.).

For the first fifteen days of July oat and pea forage was fed morning and noon and mixed hay (mostly clover) at night. For the rest of the month alfalfa forage was fed morning and noon, hay at night. The same grain was fed in July as in June.

The ration for August was mixed hay (mostly clover) three times daily until the fifteenth. After the fifteenth, hay (alsike clover and timothy) morning and night, and oat and pea forage at noon. A mixed grain, fed morning and night during the first half of month contained three parts wheat bran, three parts corn meal, three parts ground oats, one part wheat middlings, one part linseed meal (O. P.), one part ground flaxseed. For the latter half of the month the mixed grain contained five parts wheat bran five parts corn meal, four parts gluten feed, two parts ground oats, one part wheat middlings, one part cottonseed meal, one part linseed meal (O. P.), one part ground flaxseed.

For September the ration was alfalfa forage in the morning, mixed hay (mostly timothy) at noon, and corn forage at night with the same mixed grain twice a day that was fed for the latter half of August.

For the first twenty days of October alfalfa forage was fed in the morning, mixed hay (mostly timothy) at noon and sorghum forage at night. After the twentieth, beets were fed morning and night and hay at noon. The mixed grain fed throughout the month was composed of six parts wheat bran, three parts gluten feed, one part corn meal, one part wheat middlings, one part linseed meal (O. P.).

The ration for November was corn silage morning and night, clover hay at noon, and the same mixed grain that was fed during October.

The ration for December was silage and hay the same as in November with a mixed grain consisting of five parts wheat bran, five parts of gluten feed, two parts wheat middlings, two parts linseed meal (O. P.), one part corn meal, one part ground oats.

Record of the amounts of the different foods consumed by the different animals, and the milk yield, will be found elsewhere in this report where the results of certain investigations are discussed.

Poultry.

A breeding experiment with fowls looking especially toward the improvement in egg production has been continued. This experiment which was at first started with pullets of four breeds (White Leghorn, Black Minorca, White Plymouth Rock and Buff Cochin), was found to require so much attention that work was continued with but two breeds — the Buff Cochin and White Leghorn; the one breed being of rather small size, very active, and about the best of layers; the other of large size, very quiet disposition and a moderate layer. It was thought that more pronounced results might be obtained with these than with breeds more intermediate in the several characteristics.

From the hen of each breed that, among six of each tested, gave for two years the largest product of eggs in number and weight, six pullets were bred — also from the hen of each breed giving the poorest egg yield, six pullets were bred. Of these pullets, the one of the best record in one lot and the one of poorest record in the other will be bred again. At the start a male had to be used from a dam whose record was unknown, and no conclusions can therefore be made from the records of the first lot of pullets. The intended sires of the second generation however, have been bred from recorded dams. In order to prevent too great inbreeding toward the end of the experiment, male birds were bred from hens giving next the best and next the poorest record, and these are reserved for breeding; cockerels again being bred in the same way for sires of the next generation.

This experiment has now made all the progress that perhaps could be made in two years. But any reliable information in regard to the laws of breeding and inheritance can not be obtained without some years of careful record. It is not possible to predict just how many generations must be before certain traits, developed considerably away from the normal, become so fixed that any mating although carefully made may not obscure or destroy them. The certainty, however, with which many breeds established by the fancier can be depended upon to reproduce certain characteristics, gives encouragement to the belief that still further development in some directions may be brought about by selection and fixed by careful breeding.

Whether or not within any reasonable length of time, by breeding from only the very best layers the prolificacy of a strain can be definitely increased — whether or not breeding from the poorest layers, though vigorous and healthy birds, will cause rapid deterioration in the laying qualities of an established breed — whether such a breed as the Leghorn has been developed to the point where it is only a question of proper feeding and careful general management to obtain the highest possible egg yield, or whether the capacity for egg production can be further improved by breeding — whether or not the laying qualities of such a breed as the Cochin can be greatly improved without losing appreciably the size and typical shape — whether or not breeding for several generations from the best and poorest layers will develop easily recognizable types in the two lines, are all questions of great interest to the breeder and poultryman, but can not be answered satisfactorily except by several years of careful experiment. It is hoped that this breeding experiment may help to answer some of these questions.

In growing, this past year, some pullets for use in feeding experiments which are now under way, the cost of hatching and of food for growing was recorded for the purpose of determining approximately the cost of young fowls, as they are usually grown on the farm. As the information obtained as part of an experiment not complete may be of service in itself, the results are here given.

About 130 chicks were hatched by hens in the usual manner. They were Cochins and Leghorns. The Leghorns were hatched a little later in the season, during milder weather, and the eggs were more strongly fertile so the cost of the chicks when hatched was considerably less. The eggs were tested first after eight days and the second time on the eighteenth day. One hundred and seventeen Cochin eggs were set, 11.1 per cent proving infertile. After the second testing 65 per cent of the eggs remained; 77.6 per cent of the tested eggs hatched, or 50.4 per cent of all eggs set. Allowing for all accidents and losses in hatching, 46.1 per cent of all eggs set were represented by strong healthy chicks. One hundred and one Leghorn eggs were set, 9.9 per cent proving infertile. After the second testing 83.2 per cent of the eggs remained; 91.7 per cent of the tested eggs hatched, or 76.2 per cent of all eggs set. Allowing for all losses in hatching, 75.2 per cent of all eggs set were represented by strong, healthy chicks.

The hens used were nearly all Cochin or of Game–Cochin cross and were tame and easily handled. They were given water to drink and were taken from the nests and fed once daily all the Indian corn and mixed grain they would eat. The mixed grain consisted of four parts corn meal, two parts buckwheat middlings, two parts wheat bran and one part each of wheat middlings, ground oats, linseed meal (O. P.) and cottonseed meal. In every twenty pounds of this mixture one ounce of salt was thoroughly mixed. Of the food taken by one lot of hens, 70.8 per cent was whole corn and for the other 73.9 per cent. For hatching the Cochin eggs nine hens were used the first week and eight for the rest of the time. For hatching the Leghorn eggs eight hens were used for three weeks. The hens with the first lot of eggs consumed of total food an average per day per hen of 1.53 ounces, and the average cost of food per hen for the twenty-one days was 2.06 cents. The average cost in food for hens when hatching Cochin chicks was .32 cents for each chick hatched. Rating the eggs at twenty-four cents per dozen, the cost of each chick when hatched was 4.65 cents. The hens with the second lot of eggs consumed on the average 1.12 ounces of food per day per hen, and the average cost of food per hen for the twenty-one days was 1.5 cents. The average cost in food for the hens while hatching Leghorn chicks was .16 cents for each chick. Rating the eggs at twenty-four cents per dozen, the cost of each Leghorn chick when hatched was 2.82 cents.

The average of all made the cost in food for sitting hens .22 cents for every chick hatched. Rating eggs at twenty-four cents per dozen, every strong healthy chick cost when hatched, 3.58 cents. At fifteen cents per dozen for eggs the cost per chick was 2.32 cents.

The young chicks were kept indoors a few days and then put with the hen out-of-doors and allowed to run at will in an apple orchard, the hen being confined in a small coop after the ordinary method. The average time of keeping the hens with the Cochin chicks was six weeks and hens were kept with the Leghorn chicks on the average a little over five weeks. The food for the growing chicks was mixed grain, cracked wheat, skim-milk, dessicated beef and finely cut fresh bone. The first mixed grain fed was composed of two parts corn meal, and one part each of wheat-bran, ground oats, wheat middlings, buckwheat middlings and linseed meal (O. P.). Another mixed grain consisted of four parts corn meal, two parts buckwheat middlings, two parts of wheat bran, and one part each of wheat middlings, ground oats, linseed meal (O. P.) and linseed meal (N. P.). To every twenty pounds of the mixture one ounce of salt. A third mixture was the same except that two parts of old process linseed meal were used in place of one each of new and old process. The chicks were entirely healthy at all times and suffered from no disease. The few lost were from accidents.

When the young fowls were put into the poultry houses and the sexes separated, which was for the Cochins at the average age of 109 days and for the Leghorns at the average age of eighty-four days, the Cochins averaged 4.05 pounds in weight and the Leghorns, 1.83 pounds. The total cost of all food consumed up to this time averaged 19.71 cents per chick for the Cochins and 9.77 cents for the Leghorns. The cost per pound gain in weight made by the Cochins was 4.99 cents and of that by the Leghorns, 5.65 cents. Including the cost of hatching, the average total cost of each Cochin chick at this time was 24.36 cents and of each Leghorn, 12.59 cents or 6.01 cents per pound for the former and 6.88 cents for the latter. The Cochin pullets averaged 3.56 pounds in weight and the cockerels 4.52 pounds. The Leghorn pullets averaged 1.65 pounds and the cockerels 2.06 pounds.

The Cochin cockerels were fed separately for a short period and then caponized and used in another feeding trial. Had they been sold, when separated, at the local market price, twelve cents per pound, they would have more than paid the cost of food up to this time for all in the lot. The cost of feeding the pullets from this time (September seventh), until November twenty-first, was an average of 20.07 cents per fowl. Deducting the market poultry value of the cockerels at the time separated from the total cost of all the lot would leave the net cost of eggs, hatching and food for the Cochin pullets averaging 5.53 pounds in weight, 13.24 cents apiece.

The Leghorn cockerels were fed for some time after they were separated from the pullets before being sold. The cost of feeding the Leghorn pullets from September seventh to November twenty-first, was 13.09 cents apiece. Deducting the local market value of the cockerels at the time of removal from the total cost of all birds in the lot would leave the total net cost for the Leghorn pullets averaging 2.81 pounds at 16.78 cents each. The sexes were about equal with the Cochins, but there was an unusual excess in the number of pullets among the Leghorns hatched (thirty-seven per cent more pullets than cockerels), so that the poultry value of the cockerels represented a lesser proportion of the value of food consumed. Had the sexes been equal, at the same proportionate cost for growing, and considering the poultry value of the cockerels, the net cost of Leghorn pullets would have been 13.55 cents apiece, nearly the same as that of the Cochins.

In calculating the cost of the food used, wheat was rated at sixty-five cents per bushel, corn at twenty dollars per ton, corn meal at twenty-two dollars, wheat bran eighteen dollars, buckwheat middlings eighteen dollars, wheat middlings twenty dollars, ground oats twenty-six dollars, linseed meal (O. P.) twenty-eight dollars, linseed meal (N. P.) twenty six dollars, cottonseed meal thirty dollars, dessicated beef at two cents per pound, fresh bone at one-half cent per pound and skim milk at twenty-four cents per 100 pounds.

Pig Feeding — Wet and Dry Food.

It has been a common practice in this State where pigs are generally kept for the purpose of utilizing skim milk, whey, etc., to give (except when feeding corn on the cob) only wet food, the ground grain being mixed with water, skim milk, or whey. Some experimenters and writers have concluded that it was more economical to feed grain food dry, and some have concluded that the grain was more profitably fed wet. In nearly all of the feeding experiments at this station the grain has been fed to hogs dry. The question of wet or dry food has often been asked, and to furnish additional information concerning this question a few feeding trials have been made at this station.

One experiment was made with fourteen hogs, of the average weight at the beginning of 138 pounds, and at the close averaging 217 pounds weight. These hogs were in two equal lots, "A" and "B;" three Poland China, two Berkshire and two Duroc in each. The treatment had previously been the same for the hogs in each lot. Only ground grain and water was given both lots, except a little salt daily and charcoal once a week — for the first four weeks, one pound a week and for the remainder of time three-quarters pound per week to each lot.

The grain for lot "A" was mixed with from two to three times its weight of water and allowed to stand for about twenty-four hours. The hogs were also given, in a separate trough, all the water in addition that they would drink. To lot "B" was fed the same amount of grain dry. All the water wanted was available at all times in a separate trough in another part of the pen. Except the one difference, the rations for the two lots were exactly similar at all times. The hogs in lot "B" were at no time fed more than they would rapidly and eagerly eat; but the wet food for lot "A" was always eaten very much faster.

A mixed grain was fed at morning and noon and corn meal at night. The feeding trial was divided into three periods. During the first from June eight to June twenty-nine, "mixed grain No.

25" was fed, consisting of six parts wheat bran, three parts cottonseed meal, two parts wheat middlings, two parts ground oats, one part linseed meal (O. P.); for the second period, from June twenty-nine to August three, "mixed grain No. 5," consisting of three parts corn meal, one part wheat bran, one part cottonseed meal; for the third period, from August three to September fourteen, "mixed grain No. 6," consisting of six parts corn meal, one part wheat bran, one part linseed meal (N. P.).

The hogs were weighed individually once a week. During the first period lot "A" made slightly the better gain; during the second, there was the same very slight difference, this time in favor of lot "B," and during the third period there was almost no difference. The total gains made by each lot for the whole trial were almost exactly the same — 549 pounds for lot "A" and 548 pounds for lot "B." The total food consumed was the same for each lot. Considerably more water was taken by the lot having the wet food.

It has been assumed in our feeding experiments that when dry grain food was given a lot of pigs, the food was more evenly distributed for much more time was required for it to be eaten. The observations made during the experiment, while, of course, showing nothing conclusive, are entirely in accord with this supposition. Only once during any week of the whole trial did any animal in lot "B" lose in weight, and in this instance lost but one pound. In six instances did animals in lot "A" lose in weight during the week, the loss running from two to nine pounds. The largest total gain, that of 9.3 per cent, made during any week, and the smallest total gain, a loss of .3 per cent, was made by lot "A." The largest gain for lot "B" any week was 8.9 per cent, and the smallest, one of 2 per cent. After the close of the experiment when the hogs were sold and killed, the average loss in dressing for market was 22.8 per cent for lot "A" and 22.2 per cent for lot "B" — practically no difference. The results obtained during the trial calculated to the average per day for each 100 pounds live weight fed for each period are given in the following table:

LOT "A"—WET GRAIN FOOD (SOAKED 24 HOURS).

Average per day for each 100 pounds live weight fed.

Average weight per pig at beginning	Days in period.	PERIOD.	Gain in weight.	Salt fed.	Total water.	Total mixed grain No. 25.	Total corn meal.	Total food.	Nutritive ratio.	Total water-free food.	Water-free food for each pound gain in weight.
			Lbs.	Ozs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.
139.0	21	June 8 to June 29................	.49	.29	9.87	1.42	.70	2.12	1:4.1	1.89	3.86
154.0	35	June 29 to August 3	.47	.26	8.66	No. 5. 1.41	.68	2.09	1:5.7	1.85	3.94
181.1	42	August 3 to September 14	.43	.29	8.14	No. 6. 1.39	.69	2.08	1:6.7	1.84	4.28

LOT "B"—DRY GRAIN FOOD.

Average per day for each 100 pounds live weight fed.

Average weight per pig at beginning	Days in period.	PERIOD.	Gain in weight.	Salt fed.	Total water.	Total mixed grain No. 25.	Total corn meal.	Total food.	Nutritive ratio.	Total water-free food.	Water-free food for each pound gain in weight.
138.1	21	June 8 to June 29................	.47	.29	7.58	No. 25. 1.43	.70	2.13	1:4.0	1.90	4.04
152.6	35	June 29 to August 3	.49	.26	8.08	No. 5. 1.40	.68	2.08	1:5.6	1.84	3.76
181.3	42	August 3 to September 14	.42	.29	7.17	No. 6. 1.39	.69	2.08	1:6.7	1.84	4.38

Another feeding trial was made with two lots of hogs, in which wet food was again contrasted with dry food, and in this trial they were allowed all the food they would consume. Eight hogs were in each lot—two Poland China, two Berkshire, two Duroc, one Chester White and one Berkshire-Cheshire cross bred. The hogs averaged about 133 pounds weight when the trial began and about 213 pounds weight at its close.

The food consisted of corn meal and a mixed grain composed of five parts wheat bran, three parts cottonseed meal, one part linseed meal (O. P.) and one part wheat middlings. The rations were nearly the same for two periods, one from February ninth to March sixteenth and the other from March sixteenth to April thirteenth. The hogs in lot "D" having the food which was mixed with water and soaked about twenty-four hours, ate a little more than those in lot "C" having dry food and made a slightly more economical gain, the cost of the gain in weight being 4.7 per cent less than for the lot having dry food. Lot "D" took a very little more corn meal in proportion to the mixed grain than did lot "C" and the "nutritive ratio" of their ration was very slightly broader in consequence.

There was an excessive quantity of food taken by the hogs in both lots, and two hogs in lot "D" suffered from indigestion, etc., after the close of the trial and one (Duroc) died from congestion of liver following indigestion. The increase in weight, as in the first feeding experiment, was less regular with the lot having wet food. The greatest gain during any week for lot "C" was one of 7.8 per cent and the least, one of 2.8 per cent. The greatest for lot "D" was a gain of 9.3 per cent and the least, one of less than one per cent. After the close of the feeding trial the average loss in dressing five hogs from lot "D" was 24.2 per cent and the average loss in dressing the eight hogs in lot "C" was 22.9 per cent.

The results of feeding calculated to the average per day for 100 pounds live weight fed are given in the table following:

LOT "C" — DRY FOOD.

Average per day for each 100 pounds live weight fed.

Average weight per pig at beginning.	Days in period.	PERIOD.	Gain in weight.	Salt fed.	Total water.	Total mixed grain No. 30.	Total corn meal.	Total food.	Nutritive ratio.	Total water-free food.	Water-free food for each pound gain in weight.
Lbs.			Lbs.	Ozs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.
135.	35	February 9 to March 16	.88	.23	7.96	.78	2.71	3.49	1:6.2	2.90	3.30
212.8	28	March 16 to April 13..............	.50	.23	5.91	.51	1.73	2.24	1:6.2	1.86	3.72

LOT "D" — WET FOOD.

Average per day for each 100 pounds live weight fed.

Average weight per pig at beginning.	Days in period.	PERIOD.	Gain in weight.	Salt fed.	Total water.	Total mixed grain No. 30.	Total corn meal.	Total food.	Nutritive ratio.	Total water-free food.	Water-free food for each pound gain in weight.
131.6	35	February 9 to March 16	.95	.23	8.60	.80	2.77	3.57	1:6.4	2.96	3.12
213.2	28	March 16 to April 13..............	.53	.23	6.06	.49	1.80	2.29	1:6.4	1.90	3.56

Pig Feeding — Different Breeds.

Several lots of pigs of different breeds have during the year been fed from birth, feeding them with the mother until they had learned to eat readily from the trough. The pigs were of Berkshire and Poland China breeds and of Poland China-Duroc cross. Three pigs of Berkshire-Cheshire cross were also fed for a short time with the others. Of Poland China and Berkshire there were eight pigs in each lot throughout the trial. Of Poland China-Duroc cross there were seven pigs while they were fed with the sow and six pigs for the rest of the time.

For the first four weeks they were fed wheat bran and skim milk. For the next period of five to six weeks, during part of which time the sow was still with them, they were fed skim milk and a mixture ("No. 1") of equal parts wheat bran and wheat middlings. For periods following they were fed besides skim milk, grain mixtures numbered 2, 3, 4 and 5. No. 2, consisted of equal parts wheat bran, wheat middlings and corn meal. No. 3, of four parts corn meal, one part wheat bran and one part wheat middlings. No. 4, of ten parts corn meal, one part wheat bran, one part wheat middlings. No. 5, of twenty parts corn meal, two parts wheat bran, one part wheat middlings. In calculating the cost of the rations, wheat bran is rated at eighteen dollars per ton, wheat middlings at twenty dollars per ton, corn meal at twenty-two dollars per ton and skim milk at twenty-five cents per 100 pounds.

The average weight of the Berkshire pigs at beginning was 3.7 pounds, of the Poland China 2.9 pounds, and of the Poland China-Duroc cross 3.7 pounds. The average weight of the Berkshire-Cheshire cross was 2.1 pounds. At the close of the feeding trial which lasted a little less than seven months, the Berkshires averaged 198.8 pounds in weight, the Poland China's 196.5 pounds, and the Poland China-Duroc cross 197.8 pounds. All the pigs were entirely healthy throughout the trial. The cost of all gain made for the whole trial, was for the Berkshires 3.82 cents, for the Poland Chinas 3.76 cents, for the Poland China-Duroc cross 3.80 cents, — practically the same for all. The Poland China pigs were ready to leave the sow about a week younger than the others. The Berkshire sow lost most in weight while suckling the pigs and the Poland

China the least. The cost of food to restore the weight lost was for the Poland China sow 12.41 cents per pound, for the Berkshire 5.88 cents, and for the Duroc 4.96 cents per pound. Six pigs from each lot were killed and dressed at the end of the trial and the average loss in weight by dressing was for the Berkshire, 22.9 per cent; for the Poland China, 21.8 per cent, and for the Poland China-Duroc cross, 22.3 per cent. In a feeding experiment made the year before with Poland China, Duroc and Berkshire pigs at a time when little skim milk was available and only grain was fed, the Poland Chinas made a much more profitable growth than the others.

The results obtained for different periods in feeding these three lots of pigs during the past year are given in the following tables. The results are calculated to the average per day for each 100 pounds live weight fed. While not enough pigs were fed of the Berkshire-Cheshire cross to make the results directly comparable with those obtained from the others, the results are also given, as they may be of value in connection with those from other feeding trials.

BERKSHIRE.

Average per day per 100 pounds live weight fed.

Average weight each pig at beginning of period.	Days in period.	PERIOD.	Loss or gain in weight of sow.	Gain or loss in weight of pigs.	Total wheat bran.	Total mixed grain, No. 1.	Total mixed grain, No. 2.	Total mixed grain, No. 3.	Total mixed grain, No. 4.	Total mixed grain, No. 5.	Total skim milk.	Total food.	Nutritive ratio.	Total water-free food.	Water-free food for one pound gain in weight.	Total cost of food.	Cost of food for one pound total gain live weight.	Cost per pound gain in weight of pigs, considering the cost of loss in weight of sow.
Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Cts.	Cts.	Cts.
3.75	28	May 29 to June 26	—.31	.87	.74	......	......	......	......	......	6.55	7.29	1:2.50	1.33	2.37	2.31	2.64	4.75
19.00	14	June 26 to July 10	—.61	.72	......	1.07	......	......	......	......	7.47	8.56	1:2.75	1.70	15.45	2.89	4.01	9.00
26.10	21	July 10 to July 31	......	1.90	......	1.76	......	......	......	......	8.68	10.44	1:2.96	2.43	1.28	3.84	2.02	......
37.50	28	July 31 to August 28	......	1.89	......	......	2.86	......	......	......	9.72	12.58	1:3.70	3.46	1.83	5.29	2.80	......
63.60	28	August 28 to September 25	......	1.30	......	......	......	2.44	......	......	10.50	12.94	1:3.92	3.18	2.45	5.19	3.99	......
91.50	28	September 25 to October 23	......	1.16	......	......	......	......	2.40	......	6.35	8.75	1:4.88	2.77	2.39	4.26	3.67	......
126.50	28	October 23 to November 20	......	.64	......	......	......	......	......	2.39	4.53	6.92	1:5.53	2.54	3.97	3.71	5.80	......
152.90	35	November 20 to December 25	......	.74	......	......	......	......	......	2.18	3.18	5.36	1:5.88	3.21	4.35	3.15	4.26	......

Poland China.

Average per day per 100 pounds live weight fed.

Average weight each pig at beginning of period.	Days in period.	PERIOD.	Loss or gain in weight of sow.	Gain or loss in weight of pigs.	Total wheat bran.	Total mixed grain, No. 1.	Total mixed grain, No. 2.	Total mixed grain, No. 3.	Total mixed grain, No. 4.	Total mixed grain, No. 5.	Total skim-milk.	Total food.	Nutritive ratio.	Total water-free food.	Water-free food for one pound gain in weight.	Total cost of food.	Cost of food for one pound total gain live weight.	Cost per pound gain in weight of pigs considering the cost of loss in weight of sow.
Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Cents.	Cents.	Cents.
2.9	28	April 7 to May 5	—.27	.68	.91	....	....	....	....	....	6.90	7.81	1:2.47	1.50	3.66	2.55	3.75	16.03
14.9	7	May 5 to May 12	+.10	.74	....	1.08	....	....	....	....	6.94	8.02	1:2.78	1.65	1.96	2.77	3.74	3.30
18.5	35	May 12 to June 16	......	2.01	....	2.18	....	....	....	....	9.04	11.22	1:3.08	2.81	1.40	4.33	2.15	....
37.2	28	June 16 to July 14	......	1.66	....	....	1.95	....	....	....	11.08	13.03	1:3.21	2.82	1.70	4.72	2.84	....
59.4	28	July 14 to August 11	......	1.37	....	....	....	2.10	....	....	9.58	11.68	1:3.85	2.82	2.06	4.61	3.36	....
86.7	28	August 11 to September 8	......	1.11	....	....	....	....	2.47	....	6.93	9.40	1:4.79	2.83	2.55	4.37	3.94	....
119.1	28	September 8 to October 6	......	.96	....	....	....	....	....	2.35	5.72	8.07	1:5.10	2.66	2.77	3.96	4.12	....
163.1	35	October 6 to November 10	......	.66	....	....	....	....	....	2.18	3.12	5.30	1:5.91	2.24	3.39	3.13	4.74	....

POLAND CHINA–DUROC CROSS.

Average per day per 100 pounds live weight fed.

Average weight each pig at beginning of period.	Days in period.	PERIOD.	Loss or gain in weight of sow.	Gain or loss in weight of pigs.	Total wheat bran.	Total mixed grain, No. 1.	Total mixed grain, No. 2.	Total mixed grain, No. 3.	Total mixed grain, No. 4.	Total mixed grain, No. 5.	Total skim milk.	Total food.	Nutritive ratio.	Total water-free food.	Water-free food for one pound gain in weight.	Total cost of food.	Cost of food for one pound total gain, live weight.	Cost per pound gain in weight of pigs, considering the cost of loss in weight of sow.
Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs	Lbs		Lbs.	Lbs.	Cts.	Cts.	Cts.
3.7	28	May 25 to June 22	–.23	.44	.64	....	....	....	....	....	5.61	6.25	1:2.51	1.14	5.43	1.98	4.50	7.09
13.7	14	June 22 to July 6	–.35	.76	....	1.03	....	....	....	....	6.64	7.67	1:2.80	1.59	3.88	2.64	3.47	5.76
22.6	21	July 6 to July 27	....	1.49	....	1.25	....	....	....	....	9.98	11.23	1:2.67	2.13	1.43	3.69	2.48	....
33.7	28	July 27 to August 24	....	1.65	....	....	2.38	....	....	....	7.59	9.97	1:3.78	2.83	1.72	4.28	2.59	....
53.5	28	August 24 to September 21	....	1.48	....	....	....	2.32	....	....	11.68	14.00	1:3.72	3.21	2.16	5.36	3.63	....
81.8	28	September 21 to October 19	....	1.27	....	....	....	....	2.67	....	7.06	9.73	1:4.88	3.08	2.43	4.63	3.65	....
117.7	28	October 19 to November 16	....	.97	....	....	....	....	....	2.32	5.75	8.07	1:5.07	2.60	2.68	3.95	4.07	....
155.0	35	November 16 to December 21	....	.69	....	....	....	....	....	2.09	3.55	5.64	1:5.65	2.17	3.14	3.15	4.57	....

BERKSHIRE-CHESHIRE CROSS.

Average per day per 100 pounds live weight fed.

Average weight each pig at beginning of period.	Days in period.	PERIOD.	Loss or gain in weight of sow.	Gain or loss in weight of pigs.	Total wheat bran.	Total mixed grain, No. 1.	Total mixed grain, No. 2.	Total mixed grain, No. 3.	Total skim-milk.	Total food.	Nutritive ratio.	Total water-free food.	Water-free food for one pound gain in weight.	Total cost of food.	Cost of food for one pound total gain, live weight.
Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Cents.	Cents.
2.1	28	May 9 to June 6	+.03	.30	.65	......	......	......	5.24	5.89	1:2.54	1.11	3.36	1.90	6.33
17.2	14	June 6 to June 20	—.30	.33	....	.43	......	......	5.05	5.48	1:2.46	.90	45.00	1.67	5.06
26.0	35	June 20 to July 25	......	2.11	....	1.64	......	......	12.15	13.79	1:2.71	2.68	1.27	4.60	2.18
57.0	35	July 25 to August 29	......	1.34	....	......	2.17	......	8.69	10.86	1:3.54	2.77	2.07	4.34	3.24
91.8	28	August 29 to September 26	......	1.08	....	......	......	1.69	8.33	10.02	1:3.74	2.33	2.16	3.85	3.56

The results obtained in feeding also four other lots of pigs for ten weeks, during which time the sow was fed with each lot, are here given. The pigs were of Poland China, Berkshire and Duroc breeds, and of Poland China-Duroc cross.

At the beginning of feeding the average weights of pigs were: For the Poland China, 3.7 pounds, for the Berkshire, 3.3 pounds, for the Duroc, 2.5 pounds, and for the Poland China-Duroc cross bred pigs, 2.8 pounds. At the end of ten weeks the average weights were: 37 pounds for the Poland China, 38.8 pounds for the Berkshire, 31.1 pounds for the Duroc, 33.6 pounds for the Poland China-Duroc cross.

For the first five weeks the food was skim milk and wheat bran, and for the next five weeks skim milk and "mixed grain No. 7," consisting of equal parts of wheat bran and ground oats. In feeding the sow to restore the weight lost while suckling the pigs, "mixed grain No. 7" and skim milk were fed for a few days, and corn meal and skim milk for the rest of the time. In calculating the cost of food, wheat bran was rated at eighteen dollars per ton, ground oats at twenty-six dollars per ton, corn meal at twenty-four dollars per ton and skim milk at twenty-five cents per 100 pounds.

For the first period the gross cost of the gain made was least for the Poland China-Duroc cross, but considering the value of weight lost by the sow at the cost of afterward restoring it, the Berkshire pigs made the most profitable gain. For the second period the gross cost of increase of weight was least for the Poland China-Duroc cross, and considering the cost of weight lost by the sow the cost of the weight gained was least for the Durocs. The results of feeding calculated to the average per day for each 100 pounds total live weight fed, follow in tabulated form. Some of these results will be discussed later when more data from feeding trials not completed are available, and when more definite conclusions can be made.

BERKSHIRE.

Average per day per 100 pounds total live weight fed.

Average weight per pig at beginning of period.	Days in period.	PERIOD.	Loss or gain in weight of sow.	Gain or loss in weight of pigs.	Total wheat bran.	Total mixed grain No. 7.	Total corn meal.	Total skim milk.	Total food.	Total water-free food.	Water-free food for one pound total gain in weight.	Total cost of food.	Cost of food for one pound gross gain in weight of pigs.	Cost of food for one pound gain in weight of sow.	Cost of food for one pound gain in weight of pigs, considering the cost of weight lost by sow.
Lbs.			Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Cents.	Cents.	Cents.	Cents.
3.3	35	July 16 to August 20................	—.25	+.76	1.43	......	......	4.26	5.69	1.72	3.37	2.35	3.09	......	5.09
21.2	35	August 20 to September 24.........	—.38	+.65	.40	1.52	......	4.67	6.59	2.17	8.04	3.20	4.92	......	8.48
38.8	35	September 24 to November 19......	+.57	......	......	.18	2.69	.16	3.03	2.56	4.49	3.47	......	6.09	....

POLAND CHINA.

Average per day per 100 pounds total live weight fed.

Average weight per pig at beginning of period.	Days in period.	PERIOD.	Loss or gain in weight of sow.	Gain or loss in weight of pigs.	Total wheat bran.	Total mixed grain, No. 7.	Total corn meal.	Total skim milk.	Total food.	Total water-free food.	Water-free food for one pound total net gain in weight.	Total cost of food.	Cost of food for one pound gross gain in weight of pigs.	Cost of food for one pound gain in weight of sow.	Cost of food for one pound gain in weight of pigs, considering the cost of weight lost by sow.
Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cents.	Cents	Cents.	Cents.
3.7	35	July 6 to August 10……………….	−.26	+.53	.13	……	……	3.80	3.93	.53	1.96	1.07	2.02	……	5.51
20.6	35	August 10 to September 14………	−.14	+.46	……	1.33	……	3.98	5.31	1.59	4.97	2.45	5.44	……	7.48
37.0	35	September 14 to October 20 ………	+.35	……	……	.40	1.59	.58	2.57	1.81	5.17	2.49	……	7.11	………..

DUROC.

Average per day per 100 pounds total live weight fed.

Average weight per pig at beginning of period.	Days in period.	PERIOD.	Loss or gain in weight of sow.	Gain or loss in weight pigs.	Total wheat bran.	Total mixed grain, No. 7.	Total corn meal.	Total skim milk.	Total food.	Total water-free food.	Water-free food for one pound total not gain in weight.	Total cost of food.	Cost of food for one pound gro gain weight of pigs.	Cost of food for one pound gain in weight of sow.	Cost of food for one pound gain in weight of pigs, considering the cost of weight lost by sow.
Lbs.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Cents.	Cents.	Cents.	Cents.
2.5	35	July 18 to August 22	—.32	+.55	1.17	......	......	.34	1.51	1.06	4.61	1.20	2.18	......	5.62
15.1	35	August 22 to September 26	—.16	+.63	......	1.45	......	4.34	5.79	1.73	3.68	2.67	4.24	......	5.32
1.1	42	September 26 to November 7	+.47	......	......	.14	2.19	......	2.33	2.06	4.38	2.78	......	5.92	....

POLAND CHINA–DUROC CROSS.

Average per day per 100 pounds total live weight fed.

Average weight per pig at beginning of period.	Days in period.	PERIOD.	Loss or gain in weight of sow.	Gain or loss in weight of pigs.	Total wheat bran.	Total mixed grain, No. 7.	Total corn meal.	Total skim milk.	Total food.	Total water-free food.	Water-free food for one pound, total net gain in weight.	Total cost of food.	Cost of food for one pound gross gain weight of pigs.	Cost of food for one pound gain in weight of sow.	Cost of food for one pound gain in weight of pigs, considering the cost of weight lost by sow.
Lbs.			Lbs.	Lbs.	Lbs	Lbs	Lbs	Lbs.	Lbs.	Lbs	Lbs.	Cents.	Cents.	Cents.	Cents.
2.8	35	September 18 to October 23	—.68	+.79	.80	......	......	2.34	3.14	.96	8.73	1.30	1.65	......	6.05
18.9	35	October 23 to November 27.........	—.28	+.64	......	1.19	......	3.56	4.75	1.41	3.92	2.20	3.44	......	5.67
33.6	56	November 27 to January 22	+ 74	......	......	.08	2.23	4.10	6.41	2.50	3.38	3.79	......	5.12	....

Corn on the Cob and Corn Meal.

A short feeding trial was made in which corn meal in one ration was contrasted with corn on the cob in the other. Only eight pigs, all of Poland China-Duroc cross, were available for this trial, and they were divided into two lots — two sows and two barrows in each lot. Only grain, beside water and a very little salt, was fed. A mixed grain ("No. 30.") consisting of five parts wheat bran, three parts cottonseed meal, one part linseed meal and one part wheat middlings, was fed to both lots. Lot "F" was fed in addition all the corn on the cob that the pigs would eat, and lot "E," at the same time, an amount of corn meal as nearly as possible the equivalent. Of the weight of the corn on the cob, eighty-nine per cent was corn. In estimating the cost of food, corn was rated at fifteen dollars and forty cents per ton, corn meal at twenty-dollars per ton, wheat bran at eighteen dollars per ton, cottonseed meal at thirty dollars per ton, linseed meal at twenty-six per ton, wheat middlings at twenty dollars per ton.

The average weight of the pigs at the beginning was, for lot "E" 110.2 pounds, and for lot "F" 111.5 pounds. At the close of the trial the average weight for lot "E" was 173.4 pounds, and for lot "F" 155 pounds. The gain made by lot "E" cost for the first period, 16.5 per cent less than that made by lot "F," and during the second period 17.7 per cent less. The results averaged for the two periods are given in the following tabulated form:

LOT "E" — CORN MEAL.

Average per day for each 100 pounds live weight fed.

Days in period.	PERIOD.	Gain in weight.	Salt.	Water.	Mixed grain No. 80.	Total corn meal.	Total food.	Nutritive ratio.	Total water-free food.	Pounds of water-free food for each 1 lb. gain in weight.	Total cost of food.	Cost of food for one pound gain in live weight.
		Lbs.	Ozs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Cents.	Cents.
28	February 13 to March 13	.75	.21	12.36	.72	1.76	2.48	1:5.5	2.06	2.75	2.57	3.43
35	March 13 to April 17........	.70	.22	7.43	.48	1.73	2.21	1:6.1	1.84	2.63	2.27	3.26

LOT "F" — CORN ON COB.

Average per day for each 100 pounds live weight fed.

Days in period.	PERIOD.	Gain in weight.	Salt.	Water.	Mixed grain No. 30.	Total corn on cob.	Equivalent of shelled corn.	Total food.	Nutritive ratio.	Total water-free food.	Pounds of water-free food for one pound gain in weight.	Total cost of food.	Cost of food for one pound gain in weight.
		Lbs.	Ozs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Cents.	Cents.
28	February 13 to Mar. 13	.56	.21	12.10	.73	2.16	1.92	2.65	1:5.8	2.27	4.05	2.30	4.11
35	March 13 to April 17..	.48	.23	7.42	.55	1.88	1.67	2.22	1:6.1	1.90	3.96	1.90	3.96

Small plats of several varieties of sorghum seed were planted, but the weather was so unfavorable at the time of planting (on clay soil) and also at the time of ripening that a very uneven and late crop was obtained. The varieties were mostly those that have for several years given the best results here. There was so much regular routine work needing attention at the time the sorghums were ripening that no analyses of juices were made. Several larger plats of sorghum were used for forage.

The several field plats were treated with different crude chemicals, and observations on the crops and records of the yields, etc., were continued. The data will be published whenever enough are obtained to justify conclusions from them.

REPORT OF THE CHEMIST.*

The following statement indicates, in outline, the various subjects considered in this report:

I. Summary of laboratory work.
II. Arrangement of chemical work.
III. Bulletins and addresses.
IV. Experiments relating to the manufacture of Edam cheese.
V. Experiments relating to the manufacture of Gouda cheese.
VI. The use of the hygrometer in cheese-curing rooms.
VII. Study of the cheese-ripening process.
VIII. Experiments relating to the manufacture of cheese from normal milk rich in fat.
IX. Character and extent of investigation made relating to the manufacture of cheese in cheese factories during the season of 1893.
X. Tabulated averages of analyses of milk, whey and cheese.
XI. Summary of results relating to conditions of manufacture of cheese.
XII. A study of the composition of milk.
XIII. A study of the composition of whey.
XIV. A study of the composition of cheese.
XV. Loss of milk-constituents in cheese-making.
XVI. Relation of composition of milk to yield of cheese.
XVII. General summary of results of cheese investigation.
XVIII. The determination of casein in cows' milk (technical).
XIX. Trade values of fertilizing ingredients for 1893.
XX. Analyses of commercial fertilizers collected in the spring of 1893.
XXI. Analyses of commercial fertilizers collected in the fall of 1893.

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* L. L. Van Slyke, Ph. D.

I. SUMMARY OF LABORATORY WORK.

During the past year the chemical work has been carried on in the new chemical laboratory and the improved facilities have very much increased the efficiency of the work. The rapid increase of our chemical work is easily seen from the following statement:

Number of determinations made in 1890	3,418
Number of determinations made in 1891	14,524
Number of determinations made in 1892	17,258
Number of determinations made in 1893	24,648

The Station is asked to do many kinds of analytical work that are of a purely private character. In so far as work is not of a strictly personal nature and is related to agricultural products, the Station tries to do as much work as possible, so far as the regular Station work connected with investigations and official work will permit. The large amount of chemical work being done in our regular investigations excludes the possibility of doing very much outside work without enlarging our force of chemists. Persons desiring to have work done should always correspond with the Station and ascertain whether such work can be done, before they send samples.

TABULATED STATEMENT OF LABORATORY WORK FOR THE YEAR.

	In milk.	In skim-milk.	In butter-milk.	In butter.	In cheese.	In whey.	In cattle foods.	In fertilizers.	In soil.	In sorghum, syrups, etc.	In ash of plants.	In grapes.	Totals.
Determinations of nitrogen	4,662				410	512	274	1,647					7,565
Determinations of fat (Babcock test)	1,860	110	101										2,071
Determinations of fat (ether-extract)	1,391			437	563	450	179						3,020
Determinations of water	2,859				680	450							3,989
Determinations of ash	1,036				40		205		19				1,300
Determinations of crude fiber							111						111
Determinations of starch and sugar							370			92			462
Determinations of phosphoric acid								3,291			94		3,385
Determinations of potash								1,078			94		1,172
Determinations of copper									9		9		18
Determinations of iron, sodium, etc.									4		399		403
Determinations of acidity	304											23	327
Saponification of fat					112								112
Microscopical examinations	531												531
Miscellaneous determinations													182
Grand total													24,648

II. ARRANGEMENT OF CHEMICAL WORK.

The chemist gives such general and special supervision to all the different lines of work as they may require. The work done in the way of preparing bulletins and giving addresses is given below under a special head.

The present arrangement of chemical work among the assistant chemists is as follows:

Mr. C. G. Jenter has special charge of the analysis of butter, of cattle foods and similar materials, of the determination of copper in plants, soils, etc., of miscellaneous analytical work, and of photographic work.

Mr. A. L. Knisely has special charge of the analysis of milk, whey and cheese and of the microscopical examinations of milk. He has also done considerable work in relation to methods of separating and determining the different classes of nitrogen compounds in milk, whey and cheese.

Mr. W. B. Cady has special charge of all nitrogen determinations and also assists in analysis of dairy products.

Messrs. B. L. Murray and A. D. Cook give their entire time to the analysis of commercial fertilizers and fertilizing materials.

Mr. John Collins and Mr. James Horth are laboratory assistants, attending to the various kinds of routine mechanical work. Mr. Collins also has charge of the determination of fat in milk, skim-milk, etc., by the Babcock test.

Mr. A. H. Horton and R. D. Newton have charge of keeping the records connected with the investigation of dairy breeds of cattle, which require numerous and extended calculations.

III. BULLETINS AND ADDRESSES.

During the year the chemist has prepared the following station bulletins, ten in number, and aggregating 578 pages:

Bulletin No. 50 — New Series — January, 1893. (116 pages.) Summary of results of experiments made in the manufacture of cheese during the season of 1892.

Bulletin No. 52 — New Series — March, 1893. (43 pages.) Analyses of commercial fertilizers.

Bulletin No. 54 — New Series — May, 1893. (43 pages.) Experiments in the manufacture of cheese. Part 1. Manufacture of cheese from normal milk rich in fat. Part 2. Study of cheese-ripening process.

Bulletin No. 55 — New Series — May, 1893. (90 pages.) General principles relating to the composition and use of fertilizers.

Bulletin No. 56 — New Series — May, 1893. (33 pages.) Experiments in the manufacture of cheese. Part 1. The manufacture of Edam cheese. Part 2. The manufacture of Gouda cheese.

Bulletin No. 58 — New Series — July, 1893. (13 pages.) Analyses of commercial fertilizers collected in Long Island in the spring of 1893.

Bulletin No. 59 — New Series — September, 1893. (35 pages.) Analyses of commercial fertilizers collected in New York State during the spring of 1893.

Bulletin No. 60 — New Series — October, 1893. (66 pages.) Investigation relating to the manufacture of cheese. Part 1. Results of work done in No. 1 factory of E. L. Stone at Mannsville, Jefferson Co., during the season of 1893.

Bulletin No. 61.— New Series — November, 1893. (62 pages.) Investigation relating to the manufacture of cheese. Part 2. Results of work done in the factory of Mr. G. Merry, at Verona, Oneida Co., during the season of 1893.

Bulletin No. 62.— New Series — December, 1893. (77 pages.) Investigation relating to the manufacture of cheese. Part 3. Results of work done in forty-eight different factories located in eight different counties.

During the year the chemist has given the following addresses:

"What Constituent of Milk can be Used to Determine the Value of Milk for Cheese-making?" in January, 1893, before the Western Ontario Dairymen's Association, at London, Ontario, Canada.

"The Inside of a Cheese and its Relation to Milk," in February, 1893, before the Wisconsin Dairymen's Association, at Waupaca, Wis.

"The Comparative Value of Different Breeds of Dairy Cows," in February, 1893, before the Farmers' Institute, at Syracuse, N. Y., and also at Palmyra.

"How to Pay for Milk at Cheese Factories," in January, 1893, before the Farmers' Institute, at Wales Center, Erie county.

"The Use of Fertilizers," in January, 1893, before the Farmers' Institute, at Middleport, N. Y.

"The Composition of Milk and its Products," in September, 1893, at the dairy building of the New York State fair grounds.

"Some Points Relating to the Composition of Cows Milk," in August, 1893, before the World's International Congress of Chemists, at Chicago.

"The Composition of American Cheddar Cheese," in August, 1893, before the World's International Congress of Chemists, at Chicago.

"The New Method of Paying for Milk for Cheese-Making," in November, 1893, before the annual meeting of the produce exchange, at Watertown, N. Y.

"Dairy Science Applied to Dairy Legislation," in December, 1893, at Watertown, N. Y., before the New York State Dairymen's Association.

IV. EXPERIMENTS RELATING TO THE MANUFACTURE OF EDAM CHEESE.

In his last annual message to the Legislature of New York, Governor Flower suggests the desirability of greater diversification in our agricultural products. Referring to the industry of cheese manufacture, he says: "Why should farmers cater to English tastes by exporting cheese at eight cents a pound, when there is an abundant home market for fancy cheeses bringing many times the price?" The value of fancy cheeses imported into the United States probably amounts to from two to three million dollars per year. It has been doubted whether we could manufacture successfully in this county such cheese as the Edam, the Stilton, the Gouda, the Limburger, etc. As a matter of fact, several different kinds of fancy cheese have been made successfully in this country but only to a limited extent. In line with the above practical suggestions of Governor Flower, this station has undertaken some preliminary experiments in the manufacture of Edam and Gouda cheese. It is hoped that we may extend our work to other varieties in the near future. Mr. J. H. Hecker, of Timothy, Wisconsin, who had made these varieties of cheese with success, attended to the making of the cheese in these experiments, and to him we are indebted for many practical points which are not found in other descriptions of methods of manufacture.

One precaution should be stated at the outset. The results and methods contained in this report can not take the place of actual experience. To learn the successful methods of manufacture, one must be taught by a skilled maker. The results of our work will be helpful only when used properly in connection with practical, personal experience.

I. Method of Manufacture.

1. DEFINITION.

Edam cheese is a sweet-curd cheese, made from partially skimmed milk. It comes to the market in the form of round, red balls, each weighing from three and one-half to four pounds when cured. They are largely manufactured in Northern Holland and derive their name from a town which is famous as a market for this kind of cheese.

2. KIND OF MILK USED.

Milk from which one-fourth to one-third of the fat has been removed is used. Too great pains can not be taken in regard to the condition of the milk. It should be fresh, free from every trace of taint, in brief, it should be in as perfect condition as it is possible to have milk.

3. TREATMENT OF MILK BEFORE ADDING RENNET.

The temperature of the milk should be brought up to a point not below 85° F. nor much above 88° F. When the desired temperature has become constant, then the coloring matter should be added. We used Carter's cheese color, using at the rate of one and one-half to two ounces for 1,000 pounds of milk. The coloring matter should, of course, be added to the milk and thoroughly incorporated by stirring before the rennet is added.

4. ADDITION OF RENNET TO MILK.

The rennet should not be added until the milk has reached the desired temperature (85° to 88° F.) and this temperature has become constant. When the temperature reaches the desired point and remains there stationary, the rennet extract is added. In our work, Hansen's rennet extract was used, four and one half to five and one-half ounces being taken for 1,000 pounds of milk, or enough to coagulate the milk in the desired time, at the actual temperature used. The milk should be completely coagulated, ready for cutting, in about twelve to eighteen minutes from the time the rennet was added. The same precaution observed in making Cheddar cheese should be followed in making Edam cheese with reference to care in adding the rennet, such as careful, accurate measurement, dilution with pure water before addition to milk, etc.

5. CUTTING THE CURD.

When the curd breaks clean across the finger, it should be cut; the curd is cut a very little softer than in the Cheddar process as ordinarily practiced. As stated above, this stage of hardness in the curd which fits it for cutting should come in twelve to eighteen minutes after the rennet is added. First, a vertical knife is used and the curd is cut lengthwise, after which it is allowed to stand until the slices of curd begin to show the separation of whey. Then the vertical knife is used in cutting crosswise, after which the horizontal knife is at once used. Any curd adhering to the bottom and sides of the vat is carefully removed by the hand, after which the curd knife is again passed through the mass of curd lengthwise and crosswise, continuing the cutting until the curd has been cut as uniformly as possible into very small pieces.

6. TREATMENT OF CURD AFTER CUTTING.

When the cutting is completed, then one commences at once to heat the curd up to the temperature of 93° to 96° F. The heating is done as quickly as possible. While the heating is in progress, the curd is kept constantly agitated to prevent settling and consequent overheating. As soon as the curd shows signs of hardening, which the experience of the worker will enable him to determine, the whey is drawn off until the upper surface of the curd appears, when one should commence to fill the press-molds.

7. FILLING MOLDS, PRESSING AND DRESSING CHEESE.

The molds, which are described later in detail, are well soaked in warm water previous to use, in order to prevent too sudden chilling of curd and consequent checking of separation of whey. As soon as the whey is drawn off, as indicated above, one commences to fill the pressing molds. The filling should be done as rapidly as possible to prevent too great cooling of curd. When the curd has been put into the molds, its temperature should not be below 88° F. Unless care is taken to keep the curd covered, the portion that is last put into the molds may become too much cooled. In making Edam cheese on a small scale, it is a good plan to squeeze the moisture out by the hands as much as possible and then break it up again before putting in the molds, when the curd should be pressed into the mold by the hand as firmly as possible. The molds should be filled as nearly alike as possible. The cheese should weigh from five to five and one-fourth pounds each when ready for the press. When the filling of molds is completed, they are put under continual pressure of twenty to twenty-five pounds for about twenty-five or thirty minutes. While the cheese is being pressed, some sweet whey is heated to a temperature of 125° or 130° F. and this whey should not be allowed to go below 120° F. at any time while it is being used. When the cheeses are taken from their molds, each is put into the warm whey for two minutes, then removed and dressed. For dressing Edam cheese the ordinary cheese bandage cloth is used. This is cut into strips which should be long enough to reach entirely around the cheese and overlap an inch or so, and which should be wide enough to cover all but a small portion of the ends of the cheese when put in place. Before putting on the bandage, all rough projections should be carefully pared from the cheese. In putting on the bandage, the cheese is held in one hand and the bandage is wrapped carefully around the cheese so that the whole cheese is covered except a small portion on the upper and lower surface of the cheese. These bare spots are covered by small pieces of bandage cloth of a size sufficient to cover the bare surface. The bandage is kept wet with the warm sweet whey, thus facilitating the process of dressing. After each cheese is dressed it should be replaced in the pressing mold; care being taken that the bandage remains in place and leaves no portion of the surface of the cheese uncovered and in direct contact with the mold. The cheese is then put under continual pressure of 60 to 120 pounds, and kept under this continual pressure for six to twelve hours.

8. SALTING AND CURING.

There are two methods which may be employed in salting, *dry-salting and wet-salting.* In *dry-salting*, when the cheese is finally taken from the press, it is removed from the press mold, its bandage is removed completely and the cheese placed in another mold quite similar, known as the salting mold. Each cheese is placed in a salting mold with a coating of fine salt completely surrounding it. The cheese is salted in this way once each day for five or six days. Each day the cheese should be turned when it is replaced in the mold, so that it will not be rounded on one end more than another. This is for the purpose of making both ends uniform in shape, giving each the proper rounding peculiar to the shape of the cheese. In the method of wet-salting, the cheese is placed in a tank of salt brine, made by dissolving common salt in water in the proportion of about one pound of salt to two and one-half quarts of water. Each cheese is turned once a day and should be left in the brine seven or eight days. When the cheese is taken from the salting mold or salt bath it is placed in warm water and is given a vigorous, thorough brushing in order to remove all slimy or greasy substances that may have accumulated on the outer surface of the cheese. When the surface of the cheese is well cleansed, it is carefully wiped dry with a linen towel and placed upon a shelf in the curing room. In being placed on the shelves, the cheese should be placed in contact so as to support one another, until they have flattened out at both ends so much that they can stand upright alone. Then they are placed far enough apart to allow a little air space between them. Another method of securing the flattened ends is to support each cheese on opposite sides by wedge-shaped pieces of wood. After they are placed on the shelves in the curing room, they are turned once a day and rubbed with the bare hand during the first month, twice a week during the second month, and once a week after that. When any slimy substance appears on the surface of the cheese, it should be washed off at once with warm water or sweet whey. The special conditions of the curing room will be noticed in detail below. When the cheeses are about two months old, they can be prepared for market, which is done in the following manner: They are first made smooth on the surface by being turned in a lathe or in some other manner, after which the surface is colored. For coloring, some carmine is dissolved in alcohol or ammonia to get the proper shade, and in this color-bath the cheeses are placed for about one minute, when they are removed and allowed to drain, and as soon as they are dry the outside of each cheese is rubbed with boiled linseed oil, in order to prevent checking. They are then wrapped in tin-foil, which is done very much like the bandaging. Care must be taken to put the tin-foil on so that it presents a smooth, neat appearance. The cheeses are finally packed in boxes, containing twelve cheeses in each box, arranged in two layers of six each with a separate partition for each cheese.

9. Curing-room.

Much more attention must be given to the conditions of the curing-room as regards moisture and temperature than in the case of Cheddar cheese. The curing-room should be well ventilated, should be quite moist and its temperature should be kept between

50° and 65° F. These conditions are not easy to secure in any ordinary room. Some form of cellar is best adapted to secure these conditions. The amount of moisture can be determined by an instrument known as a *hygrometer*, which consists of two thermometers; the bulb of one is exposed to the air directly and is known as the dry-bulb thermometer; the bulb of the other is wrapped with a piece of cloth, preferably flannel, the lower end of which is placed in water, and this is known as the wet-bulb thermometer. The dry-bulb thermometer indicates the temperature of the air in the room; the wet-bulb thermometer indicates a lower temperature because the water evaporates from the bulb and the evaporation is accompanied by a lowering of temperature immediately around the wet-bulb. The less moisture there is in the air, the more rapidly will evaporation take place and the lower will be the temperature indicated by the wet-bulb thermometer. The greater the moisture, the less will be the amount of evaporation, and the smaller the difference between the wet and dry-bulb thermometers. When the two thermometers indicate the same temperature, then there is no evaporation taking place at the wet-bulb thermometer, because the air is saturated with moisture or holds all that it can at that particular temperature. In a curing-room suited for Edam cheese, the moisture should be between eighty-five and ninety-five per cent or a little short of saturation. When the temperature is between 50° and 65° F. the moisture is between eighty-five and ninety-five per cent if the wet-bulb thermometer is from one to two degrees F. (or ½° to 1° C.) below the dry-bulb thermometer. Undoubtedly, much better results would be secured in curing Cheddar cheese, if some attention were paid to the condition of moisture of the air in the curing-room, for it is now extremly rare to find any cheese-maker recognizing this condition at all. In the case of Edams, the cheese will check or crack and be spoiled for market, if the degree of moisture is not kept high enough. At the end of this subject, further details are given in regard to use of hygrometers in cheese curing.

Fig. 2 shows one form of hygrometer. A good hygrometer can be purchased for two dollars or more.

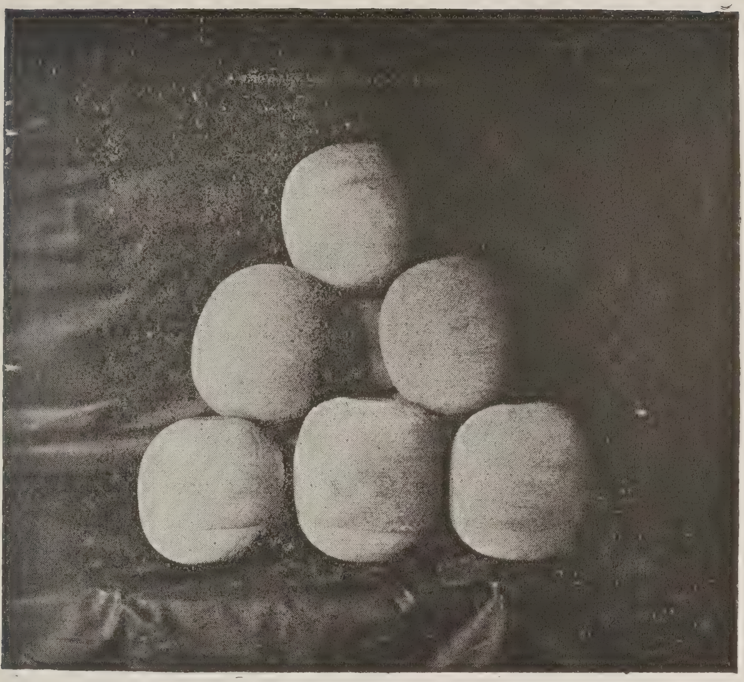


FIG. 1.— Group of Edam cheeses made at this Station.

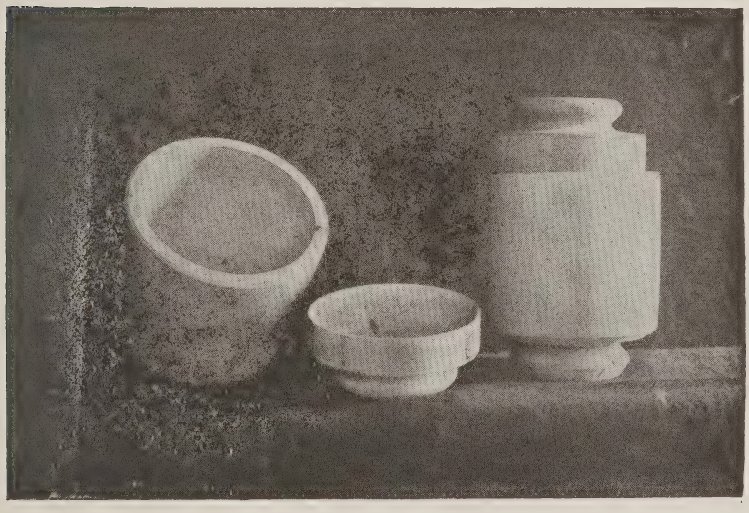


FIG 3 — Edam press-mold and cover. Inside and outside appearance.

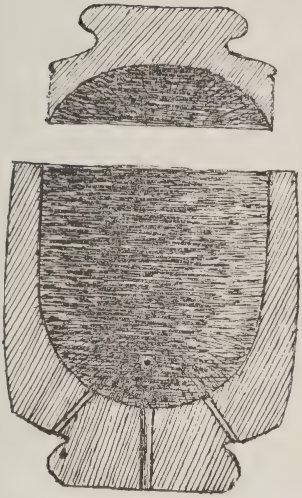


FIG. 4.— Cross-section of Edam press-mold and cover.

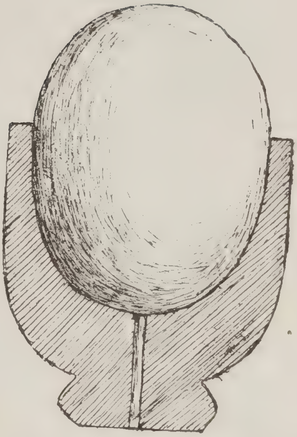


FIG. 6.— Edam salting mold in cross-section.

FIG. 5.— Salting-mold. Inside and outside appearance.

10. Utensils Employed in Making Edam Cheese.

Aside from the molds, continual press and salting vat, the same apparatus that is used in making Cheddar cheese can be used in making Edam cheese. The pressing mold is turned preferably from white wood or, in any case, from wood that will not taint. Each mold consists of two parts; the lower part constitutes the main part of the mold, the upper portion is simply a cover. The lower portion or body of the mold has several holes in the bottom, from which the whey flows when the cheese is pressed. Care must be taken to prevent these holes being stopped up by curd. This portion of the mold is about six inches deep and six inches in diameter across the top. The salting mold has no cover and the bottom is provided with only one hole for the outflow of whey; in other respects it is much like the pressing mold.

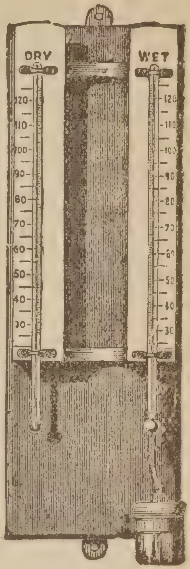


Fig. 3 shows the external appearance of the press mold with cover in position, the inner surface of the cover, and the inside appearance of the press-mold. Fig. 4 shows the press-mold and cover in cross-section. Fig. 5 shows the salting mold in external and internal appearance and Fig. 6 shows cross-section of the same.

11. Qualities of Edam Cheese.

The *flavor* of a perfect Edam cheese is difficult to describe. It is mild, clean and pleasantly saline. In imperfect Edams the flavor is more or less sour and offensive.

In *body*, a perfect Edam cheese is solid, rather dry and mealy or crumbly. This condition is secured by the use of partially skimmed milk together with the special conditions of manufacture employed.

In *texture*, the perfect Edam cheese should be close and free from pores.

12. General Remarks.

There are a few points which may be best brought to our attention by contrasting some of the conditions used in the manufacture of Edam cheese with those employed in the manufacture of our American Cheddar cheese.

1. One is made from partially skimmed milk; the other, when at its best, is made from whole milk.

2. While it is very important in making Cheddar cheese to have the milk in perfect condition, it is absolutely essential in making Edam cheese.

3. In making Cheddar cheese, the removal of moisture is largely effected in the vat by the use of a higher temperature in heating the curd. In making Edam cheese, the removal of moisture depends more upon the fineness of cutting the curd and subsequent pressing. As we shall see later, the latter process is much less economical as regards loss of milk constituents.

4. In making Cheddar cheese, more or less lactic acid is formed according to special conditions; in making Edam cheese, every effort is made to hasten the process at every stage and prevent the formation of lactic acid. In one case, we work to produce an acid curd; in the other, a curd as free as possible from acid.

5. The details of salting and curing differ radically in the two methods. In general, the manufacture of Edam cheese requires labor and care in giving attention to many more details than the manufacture of Cheddar cheese, however much the latter should have for best success.

6. Edam cheese sells for two or three times as much per pound as the best American Cheddar. It would seem that the manufacture of Edam cheese offers a legitimate channel for the outlet of partially skimmed-milk cheese, and not only that but as well an attractive line of manufacture for any one who is willing to equip himself properly for this branch of dairy industry.

II. Analyses of Milk, Whey and Cheese.

			Composition Expressed in Parts per Hundred.							From One Hundred Pounds of Milk.							
Number.	Date.		Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of casein.	Per cent. of albumen.	Per cent. of sugar, ash, etc.	Pounds.	Pounds of water.	Pounds of solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of casein.	Pounds of albumen.	Pounds of sugar, ash, etc.
	1893.																
148	Feb. 20	Milk	86.58	13.42	4.15	3.48	2.75	0.73	5.79	100	86.58	13.42	4.15	3.48	2.75	0.73	5.79
		Whey	92.76	7.24	0.39	0.94	......	....	5.91	88.00	81.63	6.37	0.34	0.83	....	....	5.20
		Green cheese	41.25	58.75	31.75	22.08	......	....	4.92	12.00	4.95	7.05	3.81	2.65	....	....	0.59
149	Feb. 21	Milk	86.17	13.83	4.45	3.58	2.80	0.78	5.80	100	86.17	13.83	4.45	3.58	2.80	0.78	5.80
		Whey	92.67	7.33	0.49	0.99	......	....	5.85	85.90	80.53	6.37	0.43	0.86	....	....	5.08
		Green cheese	43.05	56.95	30.69	20.77	......	....	5.49	13.10	5.64	7.46	4.02	2.72	....	....	0.72
150	Feb. 22	Milk	86.20	13.80	4.50	3.68	2.86	0.82	5.62	100	86.20	13.80	4.50	3.68	2.86	0.82	5.62
		Whey	92.80	7.20	0.40	1.04	......	....	5.76	86.65	80.41	6.24	0.35	0.90	....	....	4.99
		Green cheese	43.37	56.63	31.09	20.82	......	....	4.72	13.35	5.79	7.56	4.15	2.78	....	....	0.63
151	Feb. 23	Milk	87.42	12.58	3.75	3.17	2.53	0.64	5.66	100	87.42	12.58	3.75	3.17	2.53	0.64	5.66
		Whey	92.93	7.07	0.33	0.80	......	....	5.94	88.40	82.15	6.25	0.29	0.71	....	....	5.25
		Green cheese	45.43	54.57	29.83	21.20	......	....	3.54	11.60	5.27	6.33	3.46	2.46	....	....	0.41
152	Feb. 24	Milk	88.05	11.95	3.15	3.31	2.59	0.72	5.49	100	88.05	11.95	3.15	3.31	2.58	0.72	5.49
		Whey	93.14	6.86	0.47	0.92	......	....	5.47	89.70	83.55	6.15	0.41	0.83	....	....	4.90
		Green cheese	43.70	56.30	26.50	24.10	......	....	5.70	10.30	4.50	5.80	2.73	2.48	....	....	0.59
153	Feb. 25	Milk	88.56	11.44	2.65	3.13	2.51	0.62	5.66	100	88.56	11.44	2.65	3.13	2.51	0.62	5.66
		Whey	93.13	6.87	0.33	0.81	......	....	5.73	89.90	83.72	6.18	0.30	0.73	....	....	5.15
		Green cheese	47.92	52.08	23.27	23.76	......	....	5.05	10.10	4.84	5.26	2.35	2.40	....	....	0.51
154	Feb. 27	Milk	88.54	11.46	2.75	3.11	2.55	0.56	5.60	100	88.54	11.46	2.75	3.11	2.55	0.56	5.60
		Whey	92.97	7.03	0.37	0.82	......	....	5.84	88.76	82.52	6.24	0.33	0.73	....	....	5.18
		Green cheese	53.55	46.45	21.53	21.18	......	....	3.74	11.24	6.02	5.22	2.42	2.38	....	....	0.42
155	Feb. 28	Milk	88.80	11.20	2.50	3.20	2.46	0.74	5.50	100	88.80	11.20	2.50	3.20	2.46	0.74	5.50
		Whey	93.00	7.00	0.34	0.79	......	....	5.87	88.85	82.63	6.22	0.30	0.70	....	....	5.22
		Green cheese	55.34	44.66	19.73	22.42	......	....	2.51	11.15	6.17	4.98	2.20	2.50	....	....	0.28

II. Analyses of Milk, Whey and Cheese — (*Concluded*).

Number.	DATE.		COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							FROM ONE HUNDRED POUNDS OF MILK.							
			Per cent. of water.	Per cent. of total solids.	Per cent. of fat	Per cent. of casein and albumen.	Per cent. of casein.	Per cent. of albumen.	Per cent. of sugar ash, etc.	Pounds.	Pounds of water.	Pounds of solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of casein.	Pounds of albumen.	Pounds of sugar, ash, etc.
	1893.																
156	March 1	Milk	88.28	11.72	2.95	2.95	2.35	0.60	5.82	100	88.28	11.72	2.95	2.95	2.35	0.60	5.82
		Whey	93.14	6.86	0.37	0.81	......	....	5.68	88.18	82.13	6.05	0.33	0.71	....	....	5.01
		Green cheese	52.03	47.97	22.16	18.95	......	....	6.86	11.82	6.15	5.67	2.62	2.24	....	....	0.81
157	March 2	Milk	88.59	11.41	2.65	2.91	2.28	0.63	5.85	100	88.59	11.41	2.65	2.91	2.28	0.63	5.85
		Whey	93.28	6.72	0.43	0.80	......	....	5.49	89.63	83.61	6.02	0.39	0.72	....	....	4.91
		Green cheese	48.02	51.98	21.80	21.12	......	....	9.06	10.37	4.98	5.39	2.26	2.19	....	....	0.94
158	March 3	Milk	88.35	11.65	2.60	3.05	2.39	0.66	6.00	100	88.35	11.65	2.60	3.05	2.39	0.66	6.00
		Whey	93.12	6.88	0.48	0.80	......	....	5.60	89.75	83.57	6.18	0.43	0.72	....	....	5.03
		Green cheese	46.64	53.36	21.17	22.73	......	....	9.46	10.25	4.78	5.47	2.17	2.33	....	....	0.97
159	March 4	Milk	88.65	11.35	2.70	2.83	2.05	0.78	5.82	100	88.65	11.35	2.70	2.83	2.05	0.78	5.82
		Whey	92.89	7.11	0.57	0.77	......	....	5.77	89.20	82.86	6.34	0.51	0.69	....	....	5.14
		Green cheese	53.60	46.40	20.28	19.82	......	....	6.30	10.80	5.79	5.01	2.19	2.14	....	....	0.68
160	March 6	Milk	87.79	12.21	3.20	3.26	2.64	0.62	5.75	100	87.79	12.21	3.20	3.26	2.64	0.62	5.75
		Whey	92.95	7.05	0.49	0.86	......	....	5.70	89.10	82.82	6.28	0.44	0.77	....	....	5.07
		Green cheese	45.60	54.40	25.32	22.84	......	....	6.24	10.90	4.97	5.93	2.76	2.49	....	....	0.68
161	March 7	Milk	89.23	11.77	2.90	3.21	2.51	0.70	5.66	100	89.23	11.77	2.90	3.21	2.51	0.70	5.66
		Whey	92.93	7.07	0.46	0.85	......	....	5.76	89.45	83.12	6.33	0.41	0.76	....	....	5.16
		Green cheese	48.44	51.56	23.60	23.22	......	....	4.74	10.55	5.11	5.44	2.49	2.45	....	....	0.50
162	March 8	Milk	88.09	11.91	3.10	3.17	2.38	0.79	5.64	100	88.09	11.91	3.10	3.17	2.38	0.79	5.64
		Whey	92.95	7.05	0.49	0.86	......	....	5.70	89.37	83.07	6.30	0.44	0.77	....	....	5.09
		Green cheese	47.23	52.77	25.02	22.57	......	....	5.18	10.63	5.02	5.61	2.66	2.40	....	....	0.55

163	March 9	Milk	88.47	11.53	2.65	3.13	2.48	0.65	5.75	100	88.47	11.53	2.65	3.13	2.48	0.65	.75
		Whey	93.17	6.83	0.48	0.86	......	....	5.49	89.74	83.61	6.13	0.43	0.77	....	....	4.93
		Green cheese	47.37	52.63	21.64	23.00	......	....	7.99	10.26	4.86	5.40	2.22	2.36	....	....	0.32
164	March 10	Milk	88.68	11.32	2.45	3.13	2.41	0.72	5.74	100	88.68	11.32	2.45	3.13	2.41	0 72	5.74
		Whey	93.03	6.97	0.43	0.84	......	....	5.70	90.40	84.10	6.30	0.39	0.76	....	....	5.15
		Green cheese	47.70	52.30	21.46	24.70	......	....	6.14	9.60	4.58	5.02	2.06	2.37	....	....	0.59
165	March 11	Milk	88.40	11.60	2.55	3.10	2.54	0.56	5.95	100	88.40	11.60	2.55	3.10	2.54	0.56	5.95
		Whey	93.07	6.93	0.36	0.82	......	....	5.75	90.15	83.90	6.25	0.32	0.74	....	....	5.19
		Green cheese	45.68	54.32	22.64	24.00	......	....	7.68	9.85	4.50	5.35	2.23	2.36	....	....	0.76

III. Loss of Milk-Constituents.

1. LOSS OF MILK-SOLIDS IN MANUFACTURE OF EDAM CHEESE.

Table showing amount of milk-solids lost and recovered.

NUMBER OF EXPERIMENT.	Pounds of solids in 100 pounds of milk.	Pounds of solids lost in whey from 100 pounds of milk.	Pounds of solids recovered in cheese for 100 pounds of milk.	Per cent of solids in milk lost in whey.	Per cent of solids in milk recovered in cheese.
164	11.32	6.30	5.02	55.65	44.35
155	11.20	6.22	4.98	55.55	44.45
165	11.60	6.25	5.35	53.88	46.12
158	11.65	6.18	5.47	53.05	46.95
153	11.44	6.18	5.26	54.00	46.00
157	11.41	6.02	5.39	52.76	47.24
163	11.53	6.13	5.40	53.17	46.83
159	11.35	6.34	5.01	55.86	44.14
154	11.46	6.24	5.22	54.45	45.55
161	11.77	6.33	5.44	53.80	76.20
156	11.72	6.05	5.67	51.62	48.38
162	11.91	6.30	5.61	52.90	47.10
152	11.95	6.15	5.80	51.45	48.55
160	12.21	6.28	5.93	51.43	48.57

Statement of results.

The amount of milk-solids in one-hundred pounds of the milk (partially skimmed) varied from 11.2 to 12.21 pounds and averaged 11.61. Of this amount, from 6.02 to 6.34 pounds were lost in the whey, with an average of 6.21 pounds; which was equivalent to 51.43 to 55.65 per cent of the milk-solids, with an average of 53.5 per cent. These results confirm the results of our previous study of skimmed milk in respect to loss of milk-solids in cheese-making, though the losses here are greater than would ever occur in making the same milk into Cheddar cheese.

2. LOSS OF FAT IN MANUFACTURE OF EDAM CHEESE.

Table showing amount of fat lost and recovered in the manufacture of Edam cheese.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 lbs. of milk.	Pounds of fat lost in whey for 100 lbs. of milk.	Pounds of fat recovered for 100 lbs. of milk.	Per cent of fat in milk lost in whey.	Per cent of fat in milk recovered in cheese.
164	2.45	0.39	2.06	15.92	84.08
155	2.50	0.30	2.20	12.00	88.00
165	2.55	0.32	2.23	12.55	87.45
158	2.60	0.43	2.17	16.54	83.46
153	2.65	0.30	2.35	11.32	88.68
157	2.65	0.39	2.26	14.72	85.28
163	2.65	0.43	2.22	16.22	83.78
159	2.70	0.51	2.19	18.89	81.11
154	2.75	0.33	2.42	12.00	88.00
161	2.90	0.41	2.49	14.14	85.86
156	2.95	0.33	2.62	11.18	88.82
162	3.10	0.44	2.66	14.20	85.80
152	3.15	0.42	2.73	13.33	86.67
160	3.20	0.44	2.76	13.75	86.25

Statement of results.

The amount of fat in 100 pounds of the partially skimmed milk varied from 2.45 to 3.20 pounds and averaged 2.77 pounds. Of this amount, from 0.30 to 0.51 pounds of fat were lost in the whey, with an average of 0.39 pounds; which was equivalent to 11.18 to 18.89 per cent of fat in the milk, with an average of about 14 per cent. These results show a considerably larger loss of fat in the process of making Edam cheese than in the ordinary process of making Cheddar cheese.

3. Loss of Casein and Albumen in the Manufacture of Edam Cheese.

Table showing amount of casein and albumen lost and recovered in the manufacture of Edam cheese.

NUMBER OF EXPERIMENT.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein and albumen lost in whey for 100 lbs. of milk.	Pounds of casein and albumen recovered in cheese for 100 lbs. of milk.	Per cent of casein and albumen in milk lost in whey.	Per cent of casein and albumen in milk recovered in cheese.
164.......	3.13	0.76	2.37	24.28	75.72
155.......	3.20	0.70	2.50	21.88	78.12
165......	3.10	0.74	2.36	23.87	76.13
158.......	3.05	0.72	2.33	23.66	76.40
153.......	3.13	0.73	2.40	23.32	76.68
157.......	2.91	0.72	2.19	24.74	75.26
163.......	3.13	0.77	2.36	24.60	75.40
159.......	2.83	0.69	2.14	24.38	75.62
154.......	3.11	0.73	2.38	23.47	76.53
161.......	3.21	0.76	2.45	23.67	76.33
156.......	2.95	0.71	2.24	24.07	75.93
162.......	3.17	0.77	2.40	24.30	75.70
152.......	3.31	0.83	2.48	25.07	74.93
160.......	3.26	0.77	2.49	23.62	76.38

Statement of results.

The amount of casein and albumen in 100 pounds of milk varied from 2.83 to 3.31 pounds and averaged 3.1 pounds. Of this amount, from 0.69 to 0.83 pounds were lost in the whey, with an average of 0.75 pounds; which was equivalent to 21.88 to 25.07 per cent of the casein and albumen in the milk, with an average of 24.2 pounds. The Edam process showed a little larger portion of loss of casein and albumen.

IV. Relation of Casein to Albumen, Fat, Etc.

1. RELATION OF CASEIN TO ALBUMEN.

Table showing relation of casein to albumen in partially skimmed milk.

NUMBER OF EXPERIMENT.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein in 100 lbs. of milk.	Pounds of albumen in 100 lbs. of milk.	Pounds of casein for 100 lbs. of casein and albumen.	Pounds of albumen for 100 lbs. of casein and albumen.	Pounds of casein for one pound of albumen.
164	3.13	2.41	0.72	77.00	23.00	3.35
155	3.20	2.46	0.74	76.88	23.12	3.33
165	3.10	2.54	0.56	82.00	18.00	4.54
158	3.05	2.39	0.66	78.36	21.64	3.62
153	3.13	2.51	0.62	80.20	19.80	4.05
157	2.91	2.28	0.63	78.35	21.65	3.62
163	3.13	2.48	0.65	79.23	20.77	3.81
159	2.83	2.05	0.78	72.58	27.42	2.63
154	3.11	2.55	0.56	82.00	18.00	4.55
151	3.21	2.51	0.70	78.20	21.80	3.60
156	2.95	2.35	0.60	79.66	20.34	3.92
162	3.17	2.38	0.79	75.33	24.67	3.00
152	3.31	2.59	0.72	78.25	21.75	3.60
160	3.26	2.64	0.62	81.10	18.90	4.25

Statement of results.

The amount of casein in 100 pounds of milk varied from 2.05 to 2.64 pounds and averaged 2.44 pounds. The amount of albumen varied from 0.56 to 0.79 pounds and averaged 0.66 pounds. For each pound of albumen in the milk, the casein varied from 3 to 4.55 pounds and averaged 3.7 pounds. Skimming milk did not appear to change the relation existing between the casein and the albumen as found in normal milk.

2. RELATION OF FAT TO CASEIN IN SKIM MILK.

Table showing relation of fat to casein in partially skimmed milk.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of fat for one pound of casein in milk.
164	2.45	2.41	1.02
155	2.50	2.46	1.02
165	2.55	2.54	1.00
158	2.60	2.39	1.09
153	2.65	2.51	1.06
157	2.65	2.28	1.16
163	2.65	2.48	1.08
159	2.70	2 05	1.31
154	2.75	2.55	1.08
161	2.90	2.51	1.15
156	2.95	2.35	1.25
162	3.10	2.38	1.30
152	3.15	2.59	1.22
160	3.20	2.64	1.21

Statement of results.

For each pound of casein in the milk, the fat varied from 1 to 1.31 pounds, the average being 1.14 pounds. In normal milk the average is about 1.5 pounds of fat for one pound of casein.

3. RELATION OF FAT TO CASEIN IN EDAM CHEESE.

Table showing relation of fat to casein in cheese.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 pounds of cheese.	Pounds of casein in 100 pounds of cheese.	Pounds of fat for one pound of casein in cheese.
164	21.46	24.70	0.87
155	19.73	22.42	0.88
165	22.64	24.00	0.94
158	21.17	22.74	0.93
153	23.27	23.76	0.98
157	21.80	21.12	1.03
163	21.64	23.00	0.94
159	20.28	19.82	1.02
154	21.53	21.18	1.02
161	23.60	23.22	1.02
156	22.16	18.95	1.11
162	25.02	22.57	1.11
152	26.50	24.10	1.10
160	25.32	22.84	1.11

Statement of results.

The amount of fat in 100 pounds of cheese varied from 19.73 to 26.5 pounds and averaged 22.6 pounds. The amount of casein in cheese varied from 18.95 to 24.7 pounds and averaged 22.45 pounds. For each pound of casein in the cheese, the fat varied from 0.87 to 1.11 pounds and averaged one pound.

V. Influence of Composition of Milk on Yield of Cheese.

1. TABLE SHOWING RELATION OF MILK-CONSTITUENTS TO YIELD OF CHEESE.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 lbs of milk.	Pounds of casein and albumen in 100 lbs of milk.	Pounds of green cheese made from 100 lbs. of milk.	Pounds of water in cheese made from 100 lbs. of milk.	Pounds of fat in cheese made from 100 lbs. of milk.	Pounds of casein and albumen in cheese made from 100 lbs. of milk.
164	2.45	3.13	9.60	4.58	2.06	2.47
155	2.50	3.20	11.15	6.17	2.20	2.50
165	2.55	3.10	9.85	4.50	2.23	2.36
158	2.60	3.05	10.25	4.78	2.17	2.33
153	2.65	3.13	10.10	4.84	2.35	2.40
157	2.65	2.91	10.37	4.98	2.26	2.19
163	2.65	3.13	10.26	4.86	2.22	2.36
159	2.70	2.83	10.80	5.79	2.19	2.14
154	2.75	3.11	11.24	6.02	2.42	2.38
161	2.90	3.21	10.55	5.11	2.49	2.45
156	2.95	2.95	11.82	6.15	2.62	2.24
162	3.10	3.17	10.63	5.02	2.66	2.40
152	3.15	3.31	10.30	4.50	2.73	2.48
160	3.20	3.26	10.90	5.97	2.76	2.49

2. YIELD OF GREEN CHEESE FROM 100 POUNDS OF MILK.

Statement of results.

The yield of cheese from 100 pounds of milk varied from 9.6 to 11.82 pounds and averaged 10.56 pounds.

3. AMOUNT OF WATER RETAINED IN CHEESE.

In the cheese made from 100 pounds of milk there were retained from 4.5 to 6.17 pounds or water with an average of 5.16 pounds. This is a very much larger amount of water than is retained in cheese made from normal milk by the ordinary Cheddar process. Edam cheese loses about eight per cent of its weight in curing.

4. COMPARISON OF EDAM AND AMERICAN CHEDDAR CHEESE WITH REFERENCE TO PROFIT IN MANUFACTURE.

In comparing the profit derived from the manufacture of Edam and American Cheddar cheese, we must consider the character of the milk used in making Edam cheese — it is approximately one-fourth or one-third skimmed milk. American Cheddar cheese made from milk of this character would hardly wholesale, on an average, for over seven cents per pound or, say, about seventy cents for the cheese made from 100 pounds of milk. On the other hand, Edam cheese made from the same milk would wholesale for from fifteen to twenty cents per pound, which, for 100 pounds of milk, would equal from one dollar and fifty cents to two dollars. After calculating the increased cost involved in making Edam cheese, it is a conservative estimate to say that the money received for 100 pounds of milk will be about double the amount received for the same milk when made into Cheddar cheese.

5. QUALITY OF EDAM CHEESE.

The cheese made in these experiments were sent to the World's fair and were marked by experts ninety-five out of a possible 100.

Tabulated Statement of the Principal Conditions of Manufacture.

NUMBER OF EXPERIMENT.	Date.	Kind of cheese made.	Pounds of milk used.	Pounds of green cheese made.	Temperature of milk when rennet was added.	Ounces of rennet extract used per 1,000 lbs. of milk.	Time from adding rennet to cutting cured.	Temperature to which curd was heated after cutting, etc.	Time taken to heat to 98° F. or more.	Time from reaching required temp'ure to drawing whey.
	1893.				Fahr.		Min.	Fahr.	Min.	Min.
152	Feb. 24	Edam	136	14.0	86°	5½	18	93°	38	15
153	25	"	340	34.3	86°	6	17	92°	21	12
154	27	"	382	42.9	85°	5¼	20	90°	35	14
155	28	"	381	42.5	86°	5¼	19	91°	11	11
156	Mch. 1	"	380	44.9	91°	4½	16	92°	14	10
157	2	"	379	39.3	91°	4½	21	93°	16	6
158	3	"	383	39.3	89°	4½	15	93°	17	9
159	4	"	382	41.3	92°	5¼	14	94°	15	7
160	6	"	383	41.8	92°	5¼	10	93°	16	10
161	7	"	384	40.5	85°	5¼	12	95°	15	13
162	8	"	382	40.6	86°	5¼	20	95°	32	5
163	9	"	381	39.1	85°	5¼	21	94°	15	4
164	10	"	375	36.0	85°	5¼	15	95°	14	5
165	11	"	374	36.8	85°	5¼	17	95°	33	4

V. EXPERIMENTS RELATING TO THE MANUFACTURE OF GOUDA CHEESE.

I. Method of Manufacture.

1. Definition.

Gouda cheese is a sweet-curd cheese made from whole milk. In shape, the Gouda cheese is somewhat like a Cheddar with the sharp edges rounded off and sloping toward the outer circumference at the middle from the end faces. They usually weigh ten or twelve pounds, though they vary in weight from eight to sixteen pounds. They are largely manufactured in Southern Holland, and derive their name from the town of the same name. The cheeses made in these experiments had their largest diameter about ten inches, and were about four inches high when green.

2. Kind of Milk Used.

Fresh, sweet milk that has been produced and cared for in the best possible manner.

3. Treatment of Milk Before Adding Rennet.

The temperature of the milk should be brought up to a point not below eighty-eight degrees Fahrenheit nor much above ninety degrees Fahrenheit. When the desired temperature has been reached and has become constant, then the coloring matter is added. We used one ounce of Hansen's cheese color for about 1,200 pounds of milk. The coloring matter should be thoroughly incorporated by stirring before the rennet is added.

4. Addition of Rennet to Milk.

The rennet should not be added until the milk has reached the desired temperature (88°-90° F.) and this temperature has become constant. When this temperature is reached, the rennet is added. We used for 1,000 pounds of milk from four and one-half to five ounces of Carter's fresh rennet extract. The milk should be completely coagulated, ready for cutting, in fifteen or twenty minutes. The same precautions should be used in adding rennet as those previously mentioned in connection with the manufacture of Edam cheese.

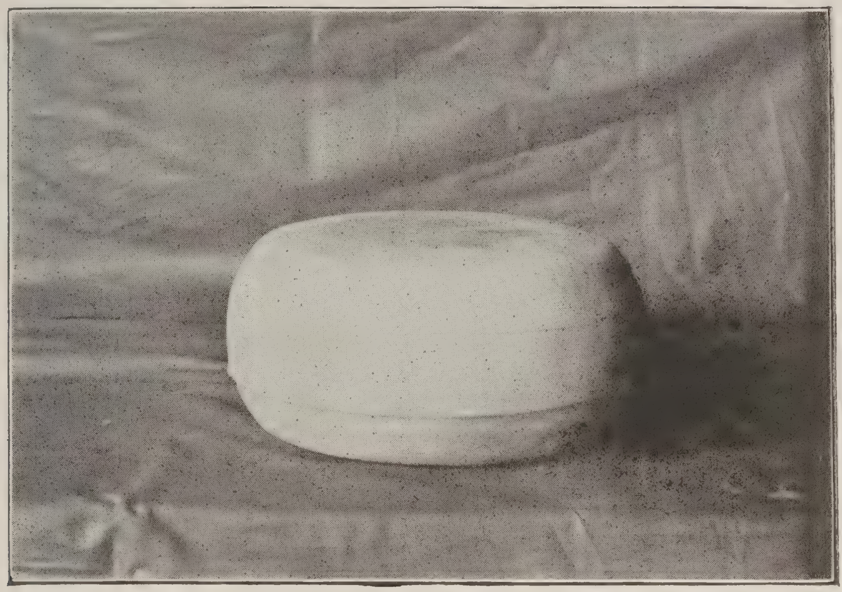


Fig. 7.— A Gouda cheese.

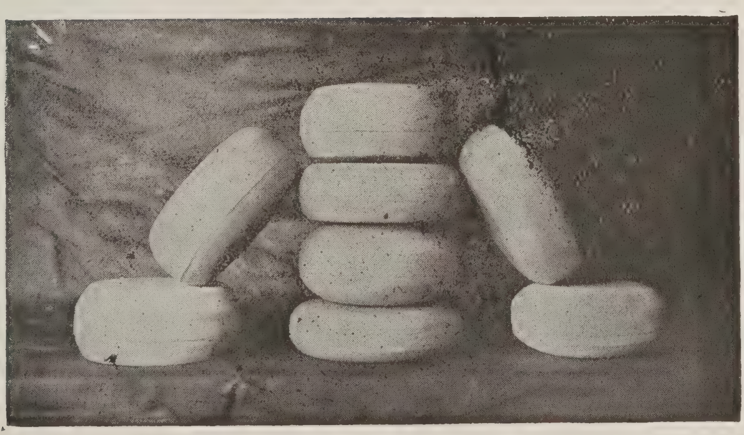
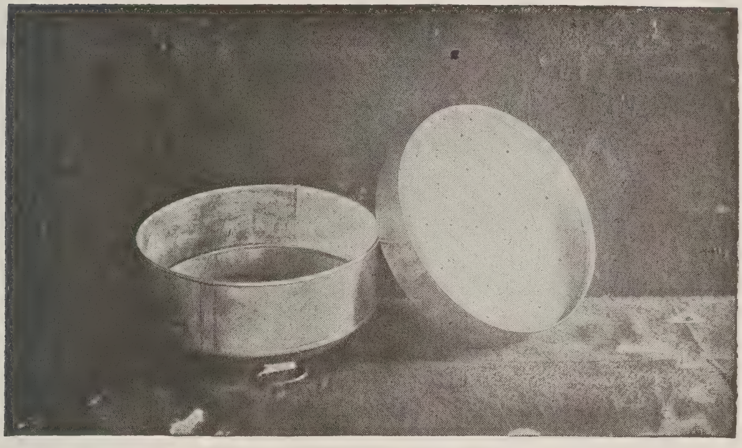


Fig. 8.— Group of Gouda cheeses made at this Station.



A. B

FIG. 9.— Two parts of Gouda mold shown separate.

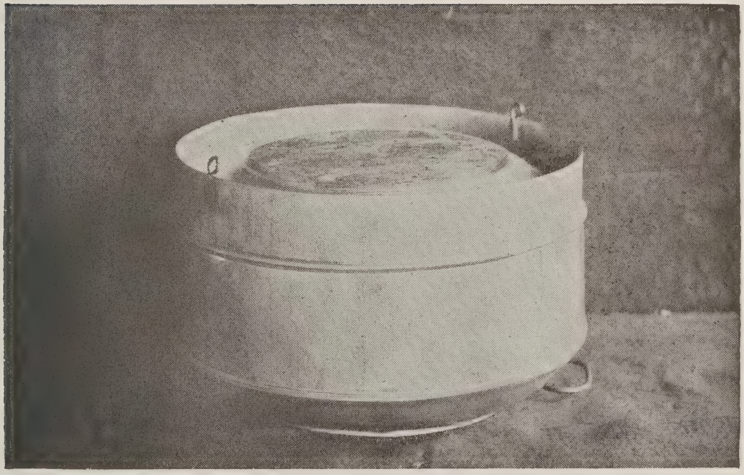


FIG. 10.— Two parts of Gouda mold united.

5. Cutting the Curd.

The curd should be cut when it is about the hardness generally observed for cutting in the Cheddar process. The cutting is done exactly as in the Cheddar process, except that the curd is cut a little finer in the Gouda cheese. Curd should be about the size of peas or wheat kernels when ready for press, and as uniform in size as possible.

6. Treatment of Curd After Cutting.

When the cutting is completed, one commences at once to heat the curd and to stir carefully. The heating and constant stirring are continued until the curd reaches a temperature of 104 degrees Fahrenheit, which should require from thirty to forty minutes. When the curd becomes rubber like in feeling and makes a squeaking sound when chewed, the whey should be run off. The whey should be entirely sweet when it is removed.

7. Pressing and Dressing Cheese.

After the whey is run off, the curd is put in the molds at once, without salting. Pains should be taken in this process to keep the temperature of the curd as near 100 degrees Fahrenheit as possible. Each cheese is placed under continual pressure, amounting to ten or twenty times its own weight, and kept for about half an hour. The first bandage is put on in very much the same manner as the bandage in Edam cheese-making. The cheese is then put in press again for about one hour. The first bandage is then taken off and a second one like the first put on with great care, taking pains to make the bandage smooth, capping the ends as before. The cheese is then put in press again and left twelve hours or more.

8. Salting and Curing.

When the cheese is taken from the press the bandage is removed, and it is placed for twenty-four hours in a curing-room like that used in curing Edam cheese, as previously described. Each cheese is then rubbed all over with dry salt until the salt begins to dissolve, and this same treatment is continued twice a day for ten days. At the end of that time each cheese is carefully and thoroughly washed in warm water and dried with a clean linen towel. The cheeses are then placed on the shelves of the curing room, turned once a day and rubbed like Cheddars. The temperature and moisture are controlled as described in curing process of Edam cheese. If the outer surface of the cheese gets slimy at any time, they are carefully washed in warm water and dried with clean towels. Under these conditions, the cheese ripens in two or three months.

9. UTENSILS EMPLOYED IN MAKING GOUDA CHEESE.

The molds, continual press and curing room are the only things needed in the making of Gouda cheese that differ from the utensils employed in making Cheddar cheese. The mold used for Gouda cheese consists of two portions, which are shown separate in Fig. 9, while in Fig. 10, the two parts are shown united, ready for pressing. These molds were made of heavy pressed tin. The inside diameter at the middle is about ten inches. The diameter of the ends is about six and one-half inches. The height of the mold (as seen in Fig. 10) is about five and one half inches and this represents the thickness of the cheese, but by pushing the upper down into the lower portion, the thickness can be decreased as desired. A simple way to make a Gouda mold is to take two rounded wash basins made of pressed tin, cut them down so that they will be about one and one-half inches deep. Then on one portion is soldered a rim of tin about three inches wide (See Fig. 9 A, or Fig. 10, lower portion of mold). On the second wash basin is soldered another rim of tin two inches wide, about one-half inch of which projects beyond the open side of the wash basin, the rest projecting on the other side (see Fig. 9 B, and Fig. 10, upper portion). This upper part or B should be made of such diameter that it will just fit into the inside of the other portion, as shown in Fig. 10. The upper portion is provided with two rings soldered on and the lower portion with two handles to facilitate handling. In the ends of the molds or the portions made from wash basins there are eighteen or twenty perforations about one eighth of an inch in diameter, made for the purpose of letting the whey run out.

II. Tabulated Statement of the Principal Conditions of Manufacture of Gouda Cheese.

NUMBER OF EXPERIMENT.	Date.	Kind of cheese made.	Pounds of milk used.	Pounds of green cheese made.	Temperature of milk when rennet was added.	Ounces of rennet extract used per 1,000 lbs. of milk	Time from adding rennet to cutting curd.	Temperature to which curd was heated after cutting, etc.	Time taken to heat to 104° F. or more.	Time from reaching required temperature to drawing whey.	Time from drawing whey to first dressing.	Time from first to second dressing.	Time of whole operation.
	1893. Feb'y.				Fahr.		Minutes.	Fahr.	Minutes.	Minutes.	Minutes.	Minutes.	Hrs. Min.
148	20	Gouda....	188	22.50	88°	10	18	102°	21	43	81	115	5–45
149	21	Gouda....	190	24.90	92°	10	11	104°	11	59	60	145	5–40
150	22	Gouda....	170	22.70	91°	10	10	100°	30	10	50	70	4–00
151	23	Gouda....	175	20.30	90°	6	15	104°	38	41	62	110	5–25

III. Loss of Milk-Constituents in the Manufacture of Gouda Cheese.

1. LOSS OF FAT IN THE MANUFACTURE OF GOUDA CHEESE.

Table showing amount of fat lost and recovered in the manufacture of Gouda Cheese.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 lbs. of milk.	Pounds of fat lost in whey for 100 lbs. of milk.	Pounds of fat recovered in cheese for 100 lbs. of milk.	Per cent of fat in milk lost in whey.	Per cent of fat in milk recovered in cheese.
151	3.75	0.29	3.46	7.73	92.97
148	4.15	0.34	3.81	8.20	91.80
149	4.45	0.43	4.01	9.66	90.34
150	4.50	0.45	4.15	7.88	91.12

Statement of results.

The amount of fat in 100 pounds of milk varied from 3.75 to 4.5 pounds and averaged 4.21 pounds. Of this amount of fat, there were lost in the whey from 0.29 to 0.43 pounds, with an average of 0.35 pounds. This was equivalent to from 7.73 to 9.66 per cent of the fat in the milk, with an average of 8.30 per cent. The loss of fat appears to be not much greater than the average loss met with in cheese factories in making Cheddar cheese. A little larger loss would be expected from the higher temperature used in heating the curd.

2. LOSS OF CASEIN AND ALBUMEN IN THE MANUFACTURE OF GOUDA CHEESE.

Table showing amount of casein and albumen lost and recovered in the manufacture of Gouda Cheese.

NUMBER OF EXPERIMENT.	Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein and albumen lost in whey for 100 pounds of milk.	Pounds of casein and albumen recovered in cheese for 100 pounds of milk.	Per cent of casein and albumen in milk lost in whey.	Per cent of casein and albumen in milk recovered in cheese.
151	3.17	0.71	2.46	22.40	77.50
148	3.48	0.83	2.65	23.85	76.15
149	3.58	0.86	2.72	24.00	76.00
150	3.68	0.90	2.78	24.45	75.55

Statement of results.

The amount of casein and albumen in 100 pounds of milk varied from 3.17 to 3.68 pounds and averaged 3.48 pounds. Of this amount, there were lost in the whey from 0.71 to 0.9 pounds, with an average of 0.83 pounds. This was equivalent to from 22.4 to 24.45 per cent of the casein and albumen in the milk, with an average of 23.7 per cent.

IV. Yield in the Manufacture of Gouda Cheese.

From 100 pounds of milk, there were made from 11.6 to 13.35 pounds of green cheese, with an average of 12.5 pounds. This was equivalent to nearly three pounds of green cheese for one pound of fat in milk. This large yield is due to retention of moisture, which varied from 4.95 to 5.79 pounds and averaged 5.4 pounds for the cheese made from the 100 pounds of milk. The amount of water in 100 pounds of cheese varied from 41.25 to 45.43 pounds and averaged 43.5 pounds. In two months, the cheese had lost about 17.5 per cent of their weight in curing.

V. Cheddar Process Modified for Gouda Cheese-making.

Eugling has suggested that it might be advantageous to make Gouda cheese like our American Cheddars, except in respect to temperature of heating curd and special conditions of curing. There is every reason to believe that this suggestion applied to Young Americas would prove most successful. It is highly probable that the curing process alone of the Gouda cheese might be found advantageous with American Cheddars.

VI. THE USE OF THE HYGROMETER IN CHEESE CURING ROOMS.

There are in the United States very few, if any, cheese factories in which any attention is paid to the amount of moisture in the air of curing rooms. This condition, as previously stated, is one which must be carefully watched and controlled in the curing of Edam and Gouda cheese. There is every reason to believe that this same condition should also be carefully studied in the curing of our American cheese. All German works on cheese-making devote considerable attention to this point. Fleischmann has published some tables which enable one by means of an hygrometer (often called psychrometer in Europe) to determine the amount of moisture present in the air. In order that cheese-makers may make use of these tables, if they wish to pay attention to the amount of moisture in curing rooms, it has been thought desirable to present them here. In Fleischmann's work, the tables are given for centigrade scale; we shall give them for both centigrade and Fahrenheit scales.

The hygrometer and the principle of its use have already been mentioned. We shall here make some additional statements regarding the details of its use, especially in connection with the tables given.

I. How to Find the Amount of Moisture in Air.

Take the reading of the dry-bulb thermometer and the reading of the wet-bulb thermometer. Subtract the latter from the former. Then turn to tables and find column which contains the difference found between the two thermometers or the number nearest it. Then follow down this column until the figure is found opposite the number in the left hand column which is the same as the temperature indicated by the dry-bulb thermometer. The number thus found indicates the relative amount of moisture in the air or how much moisture the air actually holds compared with what it would hold at that temperature if saturated. This statement can be made clearer by an illustration. Suppose that we find the reading on the two thermometers as follows:

Dry-bulb thermometer	14.6° C.	(58.3° F.)
Wet-bulb thermometer	13.4° C.	(56.1° F.)
Difference	1.2° C.	(2.2° F.)

We turn to the tables and look in the upper horizontal row (printed in heavy-faced type) for 1.2° C. (or 2.2° F.). Having found this number we run down the column until we come opposite the number indicated by the dry-bulb thermometer, 14.6° C. (or 58.3° F.) in the two vertical columns at the left (printed in heavy-faced type). This brings us to the figure eighty-six, which indicates the relative amount of moisture in the air; in other words, the air contains eighty-six per cent as much moisture as it can hold at this temperature (14.6° C. or 58.3° F.). To take another example:

Dry-bulb thermometer	19° C.	(66 2° F.)
Wet-bulb thermometer	15° C.	(59.0° F.)
Difference	4° C.	(7.2° F.)

Reference to tables shows that the air contains sixty-two per cent of all the moisture it is capable of holding at the temperature of 19° C. (or 66.2° F.).

There are hygrometers so made that one can read directly from the instrument the per cent of moisture and need not, therefore, use any tables or make any calculations. Hygrometers of any desired form can be furnished by any house dealing in physical apparatus, such as that of James W. Queen & Co., Philadelphia, or Eimer & Amend, New York City.

Suppose one desires to hold the temperature of a room between 50° F. and 65° and have the air contain from eighty to ninety-five per cent as much moisture as it can hold. How can one find how much apart the dry-bulb and wet-bulb thermometers should be? We turn to the left hand column in the table and find 50° F.; we then follow the column horizontally to the right until we come to the figure ninety-five. We then follow this column up vertically and find at the head the figure 0.7° F. which means that if the dry-bulb thermometer is 0.7° F. higher than the wet-bulb thermometer, the air contains ninety-five per cent as much moisture as it can hold, or the highest limit we want. We, then, in a similar manner, find that at 65° F. the two thermometers will be 3.6° F. apart when the air holds eighty per cent moisture, the lowest limit we want. Therefore, if we keep our two thermometers within 3° F. of each other and between the temperatures of 50° F. and 65° F., we shall have a degree of moisture varying from eighty to ninety-five per cent of saturation.

One precaution should be emphasized in reference to reading the themometer. Before one takes a reading, a current of air should be passed over the hygrometer. This may be done by fanning the instrument with the hand gently just before reading off the temperature. The object of this is to make sure that the air in contact with the wet-bulb thermometer is as dry as the rest of the air in the room; owing to evaporation, the air around the wet-bulb thermometer may contain more moisture than the rest of the air in the room. By bringing into contact with the wet-bulb thermometer some less moist air, more water evaporates, and the greater will be the difference between the readings of the two thermometers.

Fleischmann states that the air in a cheese-curing room or cellar (käsekeller) should never go below 10° C. (50° F.), and never above 18° C. (64.4° F.). The moisture should not drop below sixty-five per cent of saturation.

TABLE SHOWING PER CENT OF SATURATION OF MOISTURE IN

READING OF DRY-BULB THERMOMETER.		DIFFERENCES BETWEEN DRY-BULB									
Degrees Cent.	Degrees Fahr.	0.0°C. 0.0°F.	0.2°C. 0.4°F.	0.4°C. 0.7°F.	0.6°C. 1.1°F.	0.8°C. 1.4°F.	1.0°C. 1.8°F.	1.2°C. 2.2°F.	1.4°C. 2 5°F	1.6°C. 2.9°F.	1.8°C. 3.2°F.
		Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.
8.0	46.4	100	97	94	91	89	86	83	80	77	75
8.2	46.8	100	97	94	91	89	86	83	80	78	75
8 4	47.1	100	97	94	91	89	86	83	80	78	75
8.6	47.5	100	97	94	91	89	86	83	81	78	75
8.8	47.8	100	97	94	92	89	86	83	81	78	75
9.0	48.2	100	97	94	92	89	86	83	81	78	76
9.2	48.6	100	97	94	92	89	86	84	81	78	76
9.4	48.9	100	97	95	92	89	86	84	81	78	76
9.6	49.3	100	97	95	92	89	86	84	81	79	76
9.8	49.6	100	97	95	92	89	87	84	81	79	76
10.0	50.0	100	97	95	92	89	87	84	82	79	76
10.2	50.3	100	97	95	92	89	87	84	82	79	77
10.4	50.7	100	97	95	92	89	87	84	82	79	77
10.6	51.0	100	97	95	92	90	87	84	82	79	77
10.8	51.4	100	97	95	92	90	87	85	82	80	77
11.0	51.8	100	97	95	92	90	87	85	82	80	77
11.2	52.1	100	97	95	92	90	87	85	82	80	77
11.4	52.5	100	97	95	92	90	87	85	82	80	78
11.6	52.9	100	97	95	92	90	87	85	82	80	78
11.8	53.2	100	97	95	92	90	87	85	83	80	78
12.0	53.6	100	97	95	92	90	87	85	83	80	78
12.2	54.0	100	97	95	92	90	88	85	83	81	78
12.4	54.3	100	97	95	93	90	88	85	82	81	78
12.6	54.7	100	98	95	93	00	88	85	83	81	78
12.8	55.0	100	98	95	93	90	88	85	83	81	79
13.0	55.4	100	98	95	93	90	88	86	83	81	79
13.2	55.8	100	98	95	93	90	88	86	83	81	79
13.4	56.1	100	98	95	93	90	88	86	83	81	79
13.6	56.5	100	98	95	93	90	88	86	84	81	79
13.8	56.8	100	98	95	93	90	88	86	84	81	79
14.0	57.2	100	98	95	93	91	88	86	84	82	79
14.2	57.5	100	98	95	93	91	88	86	84	82	79
14.4	57.9	100	98	95	93	91	88	86	84	82	80
14.6	58.3	100	98	95	93	91	88	86	84	82	80
14.8	58.6	100	98	95	93	91	89	86	84	82	80
15.0	59.0	100	98	96	93	91	89	86	84	82	80
15.2	59.3	100	98	96	93	91	89	87	84	82	80
15.4	59.7	100	98	96	93	91	89	87	84	82	80
15.6	60.0	100	98	96	93	91	89	87	85	82	80
15.8	60.4	100	98	96	93	91	89	87	85	83	80
16.0	60.8	100	98	96	93	91	89	87	85	83	81
16.2	61.1	100	98	96	93	91	89	87	85	83	81
16.4	61.5	100	98	96	93	91	89	87	85	83	81
16.6	61.9	100	98	96	94	91	89	87	85	83	81
16.8	62.2	100	98	96	94	91	89	87	85	83	81
17.0	62.6	100	98	96	94	91	89	87	85	83	81
17.2	63.0	100	98	96	94	91	89	87	85	83	81
17.4	63.3	100	98	96	94	91	89	87	85	83	81
17.6	63.7	100	98	96	94	92	89	87	85	83	81
17.8	64.0	100	98	96	94	92	89	87	85	83	81
18.0	64.4	100	98	96	94	92	90	88	86	84	82
18.2	64.7	100	98	96	94	92	90	88	86	84	82
18.4	65.1	100	98	96	94	92	90	88	86	84	82
18.6	65.4	100	98	96	94	92	90	88	86	84	82
18.8	65.8	100	98	96	94	92	90	88	86	84	82

AIR AT VARIOUS TEMPERATURES ACCORDING TO HYGROMETER.

AND WET-BULB THERMOMETERS.

2.0°C. 3.6°F.	2.2°C. 3.9°F.	2.4°C. 4.3°F.	2.6°C. 4.7°F.	2.8°C. 5.0°F.	3.0°C. 5.4°F.	3.2°C. 5.8°F.	3.4°C. 6.1°F.	3.6°C. 6.5°F.	3.8°C. 6.8°F.	4.0°C. 7.2°F.
Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.
72	69	67	64	61	59	56	53	51	48	46
72	69	67	64	62	59	56	54	51	49	46
72	70	67	64	62	59	57	54	52	49	47
72	70	67	65	62	60	57	54	52	50	47
73	70	68	65	62	60	57	55	52	50	47
73	70	68	65	63	60	58	55	53	50	48
73	71	68	66	63	60	58	55	53	51	48
73	71	68	66	63	61	58	56	53	51	49
73	71	68	66	63	61	58	56	54	51	49
74	71	69	66	64	61	59	56	54	52	49
74	71	69	66	64	61	59	57	54	52	50
74	72	69	67	64	62	59	57	55	52	50
74	72	69	67	64	62	60	57	55	53	50
74	73	70	67	65	62	60	58	55	53	51
75	72	70	67	65	63	60	58	56	53	51
75	72	70	68	65	63	61	58	56	54	51
75	73	70	68	65	63	61	59	56	54	52
75	73	70	68	66	63	61	59	57	54	52
75	73	71	68	66	64	61	59	57	55	52
75	73	71	68	66	64	62	59	57	55	53
76	73	71	69	66	64	62	60	58	55	53
76	73	71	69	67	64	62	60	58	56	53
76	74	71	69	67	65	62	60	58	56	54
76	74	72	69	67	65	63	60	58	56	54
76	74	72	69	67	65	63	61	58	56	54
76	74	72	70	67	65	63	61	59	57	55
76	74	72	70	68	65	63	61	59	57	55
77	75	72	70	68	66	64	61	59	57	55
77	75	72	70	68	66	64	62	60	58	55
77	75	73	70	68	66	64	62	60	58	56
77	75	73	71	68	66	64	62	60	58	56
77	75	73	71	69	67	64	62	60	58	56
77	75	73	71	69	67	65	63	61	59	57
78	75	73	71	69	67	65	63	61	59	57
78	76	73	71	69	67	65	63	61	59	57
78	76	74	72	69	67	65	63	61	59	57
78	76	74	72	70	68	66	64	62	60	58
78	76	74	72	70	68	66	64	62	60	58
78	76	74	72	70	68	66	64	62	60	58
78	76	74	72	70	68	66	64	62	60	58
78	77	75	72	70	68	66	64	62	60	59
79	77	75	73	70	68	67	65	63	61	59
79	77	75	73	71	69	67	65	63	61	59
79	77	75	73	71	69	67	65	63	61	59
79	77	75	73	71	69	67	65	63	61	60
79	77	75	73	71	69	67	65	64	62	60
79	77	75	73	71	69	67	66	64	62	60
79	77	75	73	71	70	68	66	64	62	60
79	77	76	74	72	70	68	66	64	62	60
79	78	76	74	72	70	68	66	64	62	61
80	78	76	74	72	70	68	66	65	63	61
80	78	76	74	72	70	68	67	65	63	61
80	78	76	74	72	70	69	67	65	63	61
80	78	76	74	72	71	69	67	65	63	61
80	78	76	74	73	71	69	67	65	63	62

Table Showing Per Cent of Saturation of Moisture in Air at

Reading of Dry-bulb Thermometer.		Differences between Dry-bulb									
Degrees Cent.	Degrees Fahr.	0.0° C. 0.0° F.	0.2° C. 0.4° F.	0.4° C. 0.7° F.	0.6° C. 1.1° F.	0.8° C. 1.4° F.	1.0° C. 1.8° F.	1.2°C. 2.2°F.	1.4°C. 2.5°F.	1.6°C. 2.9°F.	1.8°C. 3.2°F.
		Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.
19.0	66.2	100	98	96	94	92	90	88	86	84	82
19.2	66.5	100	98	96	94	92	90	88	86	84	82
19.4	66.9	100	98	96	94	92	90	88	86	84	82
19.6	67.2	100	98	96	94	92	90	88	86	84	82
19.8	67.6	100	98	96	94	92	90	88	86	84	82
20.0	68.0	100	98	96	94	92	90	88	86	84	83
20.2	68.3	100	98	96	94	92	90	88	86	85	83
20.4	68.7	100	98	96	94	92	90	88	86	85	83
20.6	69.0	100	98	96	94	92	90	88	87	85	83
20.8	69.4	100	98	96	94	92	90	88	87	85	83
21.0	69.8	100	98	96	94	92	90	89	87	85	83
21.2	70.1	100	98	96	94	92	90	89	87	85	83
21.4	70.5	100	98	96	94	92	90	89	87	85	83
21.6	70.8	100	98	96	94	92	90	89	87	85	83
21.8	71.2	100	98	96	94	92	90	89	87	85	83
22.0	71.6	100	98	96	94	93	91	89	87	85	83
22.2	71.9	100	98	96	94	93	91	89	87	85	84
22.4	72.3	100	98	96	94	93	91	89	87	85	84
22.6	72.6	100	98	96	95	93	91	89	87	85	84
22.8	73.0	100	98	96	95	93	91	89	87	86	84

Various Temperatures According to Hygrometer — (*Concluded*).

and Wet-bulb Thermometers.

2.0° C. 3.6° F.	2.2° C. 3.9° F.	2.4° C. 4.3° F.	2.6° C. 4.7° F.	2.8° C. 5.0° F.	3.0° C. 5.4° F.	3.2° C. 5.8° F	3.4° C. 6.1° F.	3.6° C. 6.5° F	3.8° C. 6.8° F.	4.0° C. 7.2° F.
Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture.	Per cent moisture	Per cent moisture	Per cent moisture.
80	78	76	75	73	71	69	67	65	64	62
80	78	77	75	73	71	69	67	66	64	62
80	78	77	75	73	71	69	68	66	64	62
80	79	77	75	73	71	70	68	66	64	62
80	79	77	75	73	71	70	68	66	64	63
81	79	77	75	73	72	70	68	66	65	63
81	79	77	75	74	72	70	68	67	65	63
81	79	77	75	74	72	70	68	67	65	63
81	79	78	76	74	72	70	68	67	65	63
81	79	78	76	74	72	70	69	67	65	64
81	80	78	76	74	72	71	69	67	66	64
81	80	78	76	74	72	71	69	67	66	64
81	80	78	76	74	73	71	69	68	66	64
81	80	78	76	74	73	71	69	68	66	64
81	80	78	76	74	73	71	69	68	66	65
82	80	78	76	75	73	71	70	68	66	65
82	80	78	76	75	73	72	70	68	66	65
82	80	78	77	75	73	72	70	68	67	65
82	80	78	77	75	73	72	70	68	67	65
82	80	78	77	75	73	72	70	69	67	65

VII. STUDY OF THE CHEESE-RIPENING PROCESS.

In Bulletin No. 37, pp. 705–711, are given the results of a preliminary study of the cheese-ripening process, and the reader is referred to the above bulletin for a general discussion of the chemical changes produced by the ripening of cheese and the causes of such changes.

In October, 1892, several cheeses were made under different conditions with special reference to studying in them the chemical changes that take place in the ripening process. The details of the experiments are described in Bulletin No. 47, Part II, pp. 276-306. These cheeses were kept under the same conditions. After the first month the temperature of the room in which they were kept averaged sixty degrees F., without extreme variations.

The special conditions of manufacture to which it is desired to call attention in this connection are given below:

Experiment No. 101. The milk from which this cheese was made contained added cream. (See Bulletin No. 47, Part II, p. 276.)

Experiment No. 102. The milk from which this cheese was made had nearly half of its fat removed. (See Bulletin No. 47, Part II, p. 276.)

Experiment No. 103. In this experiment a portion of the milk had been exposed to foul air. (See Bulletin No. 47, Part II, p. 276.)

Experiment No. 104. By the conditions of manufacture employed, an excessive amount of moisture was retained in the cheese.

Experiments No. 105 and 106 were alike in every respect except in amount of rennet used; in 105, three ounces of Hansen's rennet extract were used, while in 106, nine ounces of the same extract were used.

In the table below is given the composition of the different cheeses when green and when five months old.

I. Table Showing Composition of Green Cheese and at Five Months' Age.

AGE OF CHEESE WHEN ANALYZED.	No. of experiment.	COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							FROM ONE HUNDRED POUNDS OF MILK.							
		Per cent of water.	Per cent of total solids.	Per cent of fat.	Per cent of casein and albumen.	Per cent. of casein.	Per cent of albumen and soluble casein.	Per cent of sugar, ash, etc.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of casein.	Pounds of albumen and soluble casein.	Pounds of sugar, ash, etc.
Green	101	38.15	61.85	38.13	19.53	18.89	0.64	4.19	14.16	5.40	8.76	5.40	2.77	2.68	0.09	0.59
Five months	101	29.85	70.15	44.33	21.53	13.30	8.23	4.29	12.18	3.64	8.54	5.40	2.62	1.62	1.00	0.52
Green	102	42.71	57.29	23.13	28.10	26.94	1.16	6.06	10.00	4.27	5.73	2.31	2.81	2.69	0.12	0.61
Five months	102	38.10	61.90	27.22	30 09	21.21	8.88	4.59	8.62	3.28	5.34	2.34	2.59	1.83	0.76	0.41
Green	103	37.58	62.42	35.44	23.60	22.58	1.02	3.38	11.70	4.40	7.30	4.15	2.76	2.65	6.11	0.39
Five months	103	31.94	68.06	39.95	25.39	17.22	8.17	2.72	10.10	3.23	6.87	4.03	2.56	1.74	0.82	0.28
Green	104	42.90	57.10	30.84	22.91	21.29	1.62	3.35	12.44	5.34	7.10	3.84	2.81	2.61	0.20	0.45
Five months	104	33.79	66.21	36.65	26.21	18.74	7.47	3.35	10.30	3.48	6.82	3.77	2.70	1.93	0.77	0.35
Green	105	39.60	60.40	32.12	23.81	23.00	0.81	4.47	11.80	4 67	7.13	3.79	2.81	2.71	0.10	0.53
Five months	105	35.69	64.31	36.32	25.52	16.02	9.50	2.47	10.40	3.71	6.69	3.78	2.65	1.66	0.99	0.26
Green	106	39.56	60.44	32.20	24.31	23.55	0.76	3.93	11.64	4.60	7.04	3.75	2.83	2.70	0.09	0.46
Five months	106	34.67	65.33	36.36	25.39	13.36	12.03	3.58	10.40	3.60	6.79	3.78	2.64	1.39	1.25	0.37

1. TOTAL LOSS OF WEIGHT IN THE RIPENING OF CHEESE.

Table showing loss of weight in five months.

NUMBER OF EXPERIMENTS.	CHEESE MADE FROM 100 POUNDS OF MILK.			
	Weight when green.	Weight when five months old.	Loss of weight in five months.	Pounds of loss in weight for 100 pounds of cheese in five months.
101	14.16	12.18	1.98	14.00
102	10.00	8.62	1.38	13.80
103	11.70	10.10	1.60	13.68
104	12.44	10.30	2.14	17.20
105	11.80	10.40	1.40	11.87
106	11.64	10.40	1.24	10.65

Statement of results.

1. The loss of weight for five months varied from 10.75 to 17.2 pounds for 100 pounds of cheese and averaged 13.53 pounds.

2. The proportion of total loss of weight was practically the same in cream cheese as in the skim-milk cheese.

3. The loss of weight was greatest in cheese No. 104, which contained, when green, the largest amount of water of any cheese made from normal milk.

2. LOSS OF WATER IN RIPENING OF CHEESE.

Table showing loss of water in five months.

NUMBER OF EXPERIMENTS.	IN CHEESE MADE FROM 100 POUNDS OF MILK.				
	Pounds of water in green cheese.	Pounds of water in cheese when five months old.	Pounds of water lost in five months.	Per cent of water in green cheese lost in five months.	Pounds of water lost in five months for 100 pounds of cheese.
101	5.40	3.64	1.76	32.60	12.43
102	4.27	3.28	0.99	23.20	9.90
103	4.40	3.23	1.17	26.60	10.00
104	5.34	3.48	1.86	34.83	14.95
105	4.67	3.71	0.96	20.56	8.14
106	4.60	3.61	0.99	21.52	8.50

Statement of results.

1. The per cent of water in the cheese that was lost in five months varied from 20.56 to 34.83 per cent and averaged 26.58 per cent.

2. The cream-cheese lost more water than the skim-milk cheese, but these results are not fully comparable, because the cream-cheese was made into two small cheeses and the skim-milk cheese was made into a single cheese, and the cream-cheese, therefore, had considerably greater surface in proportion to its weight.

3. Cheese No. 104, which when green contained the largest amount of water of any of the cheeses made from normal milk, lost a larger proportion of its water than any other cheese.

4. The amount of water lost in five months for 100 pounds of green cheese varied from 8.14 to 14.95 pounds and averaged 10.60 pounds.

3. LOSS OF SOLIDS IN RIPENING OF CHEESE.

Table showing loss of solids in five months.

NUMBER OF EXPERIMENT.	IN CHEESE MADE FROM 100 LBS. OF MILK.				
	Pounds of solids in cheese when green.	Pounds of solids in cheese when five months old.	Pounds of solids lost in five months.	Per cent of solids in cheese lost in five months.	Pounds of solids lost for 100 lbs. of green cheese.
101.......	8.76	8.54	0.22	2.50	1.57
102.......	5.73	5.34	0.39	6.80	3.90
103.......	7.30	6.87	0.43	5.90	3.68
104.......	7.10	6.82	0.28	4.00	2.25
105.......	7.13	6.69	0.44	6.17	3.73
106.......	7.04	6.79	0.25	3.55	2.15

Statement of results.

1. The per cent of solids in the cheese that was lost in five months varied from 2.50 to 6.80 per cent and averaged 4.82 per cent.

2. The skim-milk cheese lost more than twice the amount of solids lost by the cream-cheese and a larger amount than any other cheese. The cream-cheese lost a smaller amount of solids than any other cheese.

3. Of the cheeses made from normal milk cheese No. 104, which, when green, contained the largest amount of water and in ripening lost the largest amount of water, lost the smallest amount of solids except one.

4. The amount of solids lost for 100 pounds of green cheese varied from 1.57 to 3.9 pounds and averaged 2.88 pounds.

4. LOSS OF FAT AND CASEIN IN RIPENING OF CHEESE.

Table showing loss of fat and casein in five months in cheese made from 100 *pounds of milk.*

NUMBER OF EXPERIMENT.	Pounds of fat in green cheese.	Pounds of fat in cheese when five months old.	Pounds of casein in green cheese.	Pounds of casein in cheese when five months old.	Pounds of casein lost in five months.	Per cent. of casein in cheese lost in five months.	Pounds of casein lost for 100 lbs. of green cheese.
101 . . .	5.40	5.40	2.77	2.62	0.15	5.42	1.06
102 . . .	2.31	2.34	2.81	2.59	0.22	7.83	2.20
103 . . .	4.15	4.03	2.76	2.56	0.20	7.25	1.71
104 . . .	3.84	3.77	2.81	2.70	0.11	4.00	0.90
105 . . .	3.79	3.78	2.81	2.65	0.16	5.69	1.35
106 . . .	3.75	3.78	2.83	2.64	0.19	6.71	1.63

Statement of results.

1. A comparison of the second and third columns in the table above shows that there was no loss of fat in ripening. The cream-cheese at no time showed any leakage of fat, as the temperature was kept sufficiently low to prevent such loss.

2. In every case there was a loss of casein or nitrogen compounds, varying in amount from 0.11 to 0.22 pounds and averaging 0.17 pounds for the cheese made from 100 pounds of milk; or, calculating the loss of casein for 100 pounds of cheese, the amount varied from 0.9 to 2.2 pounds and averaged 1.48 pounds.

3. The loss of casein was greatest in the skim-milk cheese and least, with one exception, in the cream-cheese.

4. The loss of casein was a little greater in the cheese which contained the larger amount of rennet.

5. CHEMICAL CHANGES PRODUCED IN CASEIN BY RIPENING OF CHEESE.

Table showing amount of nitrogen in different forms in cheese.

NUMBER OF EXPERIMENT.	IN ONE HUNDRED POUNDS OF CHEESE.						
	Age of cheese when analyzed.	Pounds of nitrogen.	Pounds of nitrogen in forms insoluble in water.	Pounds of nitrogen in forms soluble in water.	Pounds of nitrogen in form of albuminoids.	Pounds of nitrogen in form of amides.	Pounds of nitrogen in form of ammonium compounds.
101	Green	3.09	2.99	0.10	......	......	....
101	Five months	2.92	1.80	1.12	2.64	0.28	0.078
102	Green	4.43	4.25	0.18	......	......	....
102	Five months	4.09	2.89	1.20	3.61	0.48	0.103
103	Green	3.73	3.57	0.16	......	......	....
103	Five months	3.46	2.35	1.11	3.09	0.37	0.101
104	Green	3.62	3.36	0.26	......	......	....
104	Five months	3.43	2.45	0.98	3.17	0.26	0.083
105	Green	3.76	3.63	0.13	......	......	....
105	Five months	3.55	2.22	1.33	3.11	0.44	0.124
106	Green	3.84	3.72	0.12	......	......	....
106	Five months	3.59	1.89	1.70	3.09	0.50	0.126

Statement of results.

1. Comparing the cheese when green and when five months old, we see that the amount of nitrogen compounds soluble in water has largely increased.

2. The amount of nitrogen compounds insoluble in water had largely decreased.

4. The cheese when green contained no nitrogen in the form of amide compounds, while it contained from 0.26 to 0.5 per cent of these compounds at five months.

4. The cheese when green contained no nitrogen in the form of ammonium compounds, while it contained 0.078 to 0.126 per cent at five months.

In the table below, we give the percentage of nitrogen in cheese in the different forms, or the pounds of nitrogen in different forms for 100 pounds of nitrogen (or casein) in the cheese.

TABLE SHOWING POUNDS OF NITROGEN IN DIFFERENT FORMS FOR ONE HUNDRED POUNDS OF NITROGEN IN CHEESE.

NUMBER OF EXPERIMENT.	Ages of cheese when analyzed.	Per cent of nitrogen in checse soluble in water.	Per cent of nitrogen in cheese in form of albuminoid compounds.	Per cent of nitrogen in cheese in form of amide compounds.	Per cent of nitrogen in cheese in form of ammonium compounds.
101........	Green	3.24	....	....	....
101........	Five months.	38.36	90.40	9.60	2.67
102........	Green	4.06	....	....	....
102........	Five months.	29.34	88.26	11.74	2.52
103........	Green	4.32	....	....	....
103........	Five months.	32.08	89.30	10.70	2.92
104........	Green	7.19	....	....	....
104........	Five months.	28.57	92.42	7.58	2.42
105........	Green	3.46	....	....	....
105........	Five months.	37.46	87.60	12.40	3.50
106........	Green	3.12	....	....	....
106........	Five months.	47.33	86.07	13.93	3.51

Statement of Results.

1. With a single exception, the cheese made from skim-milk contained the smallest proportion of soluble nitrogen compounds at five months.

2. The cheese made from milk containing added cream contained, with a single exception, the largest proportion of soluble nitrogen compounds at five months.

3. The cheese containing the largest amount of rennet contained considerably more of the soluble nitrogen compounds than did any other cheese at five months.

4. The amount of soluble nitrogen compounds varied from 28.57 to 47.33 per cent of the total nitrogen in the cheese and averaged 35.52 per cent.

5. The per cent of nitrogen in the form of albuminoid compounds, at five months, varied from 86.07 to 92.42 per cent of the total nitrogen in the cheese and averaged 88.34 per cent.

6. The per cent of nitrogen in the form of amide compounds varied from 7.58 to 13.93 per cent of the total nitrogen in the cheese and averaged 11.66 per cent.

7. The per cent of nitrogen in ammonium compounds varied from 2.42 to 3.51 per cent and averaged 2.92 per cent of the total nitrogen in the cheese.

6. GENERAL SUMMARY OF RESULTS RELATING TO THE CHANGES THAT TAKE PLACE IN THE RIPENING OF CHEESE.

1. *Total loss of weight in ripening of cheese.*

In five months the loss of weight varied from 10.65 to 17.2 pounds for 100 pounds of cheese and averaged 13.53 pounds.

2. *Loss of water in ripening of cheese.*

In five months the loss of water for 100 pounds of cheese varied from 8.14 to 14.95 pounds, and averaged 10.6 pounds; this was equivalent to from 20.56 to 34.83 per cent of the water in the cheese, with an average of 26.58 per cent.

3. *The loss of solids in ripening of cheese.*

In five months the loss of solids for 100 pounds of cheese varied from 1.57 to 3.9 pounds, and averaged 2.88 pounds; this was equivalent to from 2.5 to 6.8 per cent of the solids in the cheese, with an average of 4.82 per cent.

4. *Loss of fat in ripening of cheese.*

There was practically no loss of fat in five months.

5. *Loss of casein in ripening of cheese.*

In every case there was a loss of casein (nitrogen compounds) varying in amount from 0.9 to 2.2 pounds for 100 pounds of cheese, and averaging 1.48 pounds; this was equivalent to from 4 to 7.83 per cent of the total casein in the cheese, with an average of 6.15 per cent.

6. *Changes in form of casein in ripening of cheese.*

1. In every case the amount of soluble nitrogen compounds increased very much in five months. In the cheese, when green, the amount of nitrogen in soluble form varied from 0.1 to 0.26 pounds in 100 pounds of cheese, and averaged 0.16 pounds, which is equivalent to from 3.12 to 7.19 per cent of the total nitrogen in the cheese, with an average of 4.23 per cent. When five months old, the amount of soluble nitrogen varied from 0.98 to 1.7 pounds in 100 pounds of cheese and averaged 1.24 pounds, which is equivalent to from 28.57 to 47.33 per cent of the total nitrogen in the cheese, with an average of 35.52 per cent.

2. The cheese, when green, contained no nitrogen in the form of amide compounds, while, at five months, there were contained from 0.26 to 0.5 pounds in 100 pounds of cheese, with an average of 0.39 pounds, which was equivalent to from 7.58 to 13.93 per cent of the total nitrogen in the cheese with an average of 11.66 per cent.

3. The cheese, when green, contained no nitrogen in the form of ammonium compounds, while, at five months, there were contained from 0.078 to 0.126 pounds in 100 pounds of cheese, with an average of 0.103 pounds, which was equivalent to from 2.42 to 3.51 per cent of the total nitrogen in the cheese, with an average of 2.92 per cent.

4. The cheese, in the manufacture of which the largest amount of rennet was used, contained considerably more of the soluble nitrogen compounds than did any other cheese at five months.

5. The cheese made from partially skimmed milk contained the smallest proportion of soluble nitrogen compounds at five months,

while the cheese made from milk containing added cream contained, with a single exception, the largest proportion of soluble nitrogen compounds.

VIII.—EXPERIMENTS RELATING TO THE MANUFACTURE OF CHEESE FROM NORMAL MILK RICH IN FAT.

In the experiments made in the manufacture of cheese during the season of 1892, we found no milk in any considerable quantity that contained over 4.4 per cent of fat. It was, therefore, considered desirable to supplement the work of last season by making cheese from milk containing fat varying in amount from four to five per cent. The milk used varied in its fat content from 3.65 to 5.25 per cent. The milk containing 4.7 per cent of fat and more came from the well-known Jersey herd of Pittsford farms, owned by Mr. W. F. Hawley. These cows were in various stages of lactation, but those in the earlier stage predominated, the milk of strippers being excluded. The Jersey milk used came from a selected portion of the 150 animals comprising the herd. The milk used in the other experiments consisted mainly of the mixed milk of our station herd and of a herd of grade Holsteins, the cows being in various stages of lactation.

The making of the cheese was done by Mr. E. L. Stone, of Mannsville, N. Y., whose cheese factories are justly noted for the fine quality of their product.

For details relating to previous experiments, see Bulletins 37, 43, 45, 46, 47 and 50.

I. Analyses of Milk, Whey and Cheese.

Number.	DATE.		COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							FROM ONE HUNDRED POUNDS OF MILK.							
			Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of casein.	Per cent. of albumen.	Per cent. of sugar, ash, etc.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of casein.	Pounds of albumen.	Pounds of sugar, ash, etc.
	1893.																
107	Feb. 1	Milk	85.90	14.10	4.55	3.62	3.06	0.56	5.93	100	85.90	14.10	4.55	4.62	3.06	0.56	5.93
		Whey	92.94	7.06	0.34	0.97	......	....	5.75	88.97	81.85	6.22	0.30	0.85	....	....	5.07
		Green cheese	33.95	66.05	35.62	23.22	......	....	7.21	11.90	4.05	7.88	4.25	2.77	....	....	0.86
108	Feb. 2	Milk	86.32	13.68	4.30	3.77	2.97	0.80	5.61	100	86.32	13.68	4.30	3.77	2.97	0.80	5.61
		Whey	93.07	6.93	0.44	0.96	......	....	5.53	88.00	81.90	6.10	0.39	0.84	....	....	4.85
		Green cheese	36.83	63.17	32.58	24.42	......	....	6.17	12.00	4.42	7.58	3.91	2.93	....	....	0.74
109	Feb. 4	Milk	86.24	13.76	4.50	3.62	2.96	0.66	5.64	100	86.24	13.76	4.50	3.62	2.96	0.66	5.64
		Whey	93.16	6.84	0.28	0.99	......	....	5.57	87.00	81.05	5.95	0.24	0.86	....	....	4.85
		Green cheese	39.92	60.08	32.77	21.23	......	....	6.08	13.00	5.19	7.81	4.26	2.76	....	....	0.79
110	Feb. 6	Milk	86.23	13.77	4.45	3.68	3.00	0.68	5.64	100	86.23	13.77	4.45	3.68	3.00	0.68	5.64
		Whey	93.13	6.87	0.36	1.00	......	....	5.51	86.70	80.74	5.96	0.31	0.87	....	....	4.78
		Green cheese	41.28	58.72	31.13	21.13	......	....	6.46	13.30	5.49	7.81	4.14	2.81	....	....	0.86
111	Feb. 8	Milk	86.87	13.13	3.90	3.39	2.77	0.62	5.84	100	86.87	13.13	3.90	3.39	2.77	0.62	5.84
		Whey	92.80	7.20	0.35	0.92	......	....	5.93	88.80	82.40	6.40	0.31	0.82	....	....	5.27
		Green cheese	39.90	60.10	32.23	22.85	......	....	4.92	11.20	4.47	6.73	3.59	2.57	....	....	0.57
112	Feb. 9	Milk	86.54	13.46	4.10	3.41	2.75	0.66	5.95	100	86.54	13.46	4.10	3.41	2.75	0.66	5.95
		Whey	92.82	7.18	0.32	0.91	......	....	5.95	88.53	82.17	6.36	0.28	0.81	....	....	5.27
		Green cheese	38.10	61.90	33.30	22.67	......	....	5.93	11.47	4.37	7.10	3.82	2.60	....	....	0.68
113	Feb. 10	Milk	86.44	13.56	4.20	3.47	2.75	0.72	5.89	100	86.44	13.56	4.20	3.47	2.75	0.72	5.89
		Whey	92.77	7.23	0.33	0.90	......	....	6.00	88.50	82.10	6.40	0.29	0.89	....	....	5.31
		Green cheese	37.74	62.26	34.00	23.22	......	....	5.04	11.50	4.34	7.16	3.91	2.67	....	....	0.58
114	Feb. 11	Milk	86.70	13.30	4.25	3.38	2.68	0.70	5.67	100	86.70	13.30	4.25	3.38	2.68	0.70	5.67
		Whey	92.97	7.03	0.30	0.88	......	...	5.85	88.60	82.37	6.23	0.27	0.78	....	....	5.18
		Green cheese	38.00	62.00	34.91	22.86	......	....	4.23	11.40	4.33	7.07	3.98	2.60	....	....	0.49

115	Feb. 13	Milk	86.67	13.33	4.30	3.46	2.78	0.68	5.57	100	86.67	13.33	4.30	3.46	2.78	0.68	5.57
		Whey	92.94	7.06	0.27	0.95	......	....	5.87	88.37	82.13	6.24	0.24	0.81	....	....	5.19
		Green cheese	39.04	60.96	34.90	22.79	......	....	3.27	11.63	4.54	7.09	4.06	2.65	....	....	0.38
116	Feb. 14	Milk	86.74	13.26	4.15	3.32	2.55	0.77	5.79	100	86.74	13.26	4.15	3.32	2.55	0.77	5.79
		Whey	92.92	7.08	0.32	0.91	......	....	5.85	88.57	82.30	6.27	0.28	0.81	....	....	5.18
		Green cheese	38.85	61.15	33 86	21.96	......	....	5.33	11.43	4.44	6.99	3.87	2.51	....	....	0.61
117	Feb. 15	Milk	86.75	13.25	4.20	3.30	2.50	0.71	5.75	100	86.75	13.25	4.20	3.30	2.59	0.71	5.75
		Whey	93.03	6.97	0.25	0.88	......	....	5.84	88.60	82.42	6.18	0.22	0.78	....	....	5.18
		Green cheese	38.00	62.00	34.90	22.10	......	....	5.00	11.40	4.33	7.07	3.98	2.52	....	....	0.57
118	Feb. 16	Milk	86.75	13.25	4.10	3.23	2.44	0.79	5.92	100	86.75	13.25	4.10	3.23	2.44	0.79	5.92
		Whey	92.63	7.37	0.25	0.85	......	....	6.27	86.75	80.36	6.39	0.27	0.74	....	....	5.38
		Green cheese	48.22	51.78	28.90	18.80	......	....	4.08	13.25	6.39	6.86	3.83	2.49	....	....	0.54
119	Feb. 17	Milk	86.20	13.80	4.55	3.52	2.86	0.66	5.73	100	86.20	13.80	4.55	3.52	2.86	0.66	5.73
		Whey	92.82	7.18	0.44	0.92	......	....	5.82	88.57	82.21	6.36	0.39	0.81	....	....	5.16
		Green cheese	34.90	65.10	36.40	23.70	......	....	5.00	11.43	3.99	7.44	4.16	2.71	....	....	0.57
120	Feb. 18	Milk	86.77	13.23	4.30	3.37	2.69	0.68	5.56	100	86.77	13.23	4.30	3.37	2.69	0.68	5.56
		Whey	93.03	6.97	0.51	0.89	......	....	5.57	88.56	82.39	6.17	0.45	0.79	....	....	4.93
		Green cheese	38.28	61.72	33.65	22.55	......	....	5.52	11.44	4.38	7.07	3.85	2.58	....	....	0.63
121	Feb. 21	Milk	85.75	14.25	4.90	3.86	3.08	0.78	5.49	100	85.75	14.25	4.90	3.86	3.08	0.78	5.49
		Whey	92.70	7.30	0.56	1.08	......	....	5 66	87.20	80.83	6.37	0.49	0.94	....	....	4.94
		Green cheese	38.44	61.56	34.45	22.81	......	....	4.30	12.80	4.92	7.88	4.41	2.92	....	....	0.55
122	Feb. 22	Milk	86.67	13.33	4.10	3.28	2.64	0.64	5.95	100	86.67	13.33	4.10	3.28	2.64	0.64	5.95
		Whey	92.60	7.40	0.42	0.85	......	....	6.13	88.90	82.32	6.58	0.37	0.76	....	....	5.45
		Green cheese	39.20	60.80	33.60	22.70	......	....	4.50	11.10	4.35	6.75	3.73	2.52	....	....	0.50
123	Feb. 22	Milk	85.18	14 82	4.85	3.93	3.13	0.80	6.04	100	85.18	14.82	4.85	3.93	3.13	0.80	6.04
		Whey	92.50	7.50	0.31	1.01	......	....	6.18	86.00	79.55	6.45	0.27	0.87	....	....	5.31
		Green cheese	40.20	59.80	32.71	21.86	......	....	5.23	14.00	5.63	8.37	4.58	3.06	....	....	0.73
124	Feb. 23	Milk	85.13	14.87	5.10	4.00	3.18	0.82	5.77	100	85.13	14.87	5.10	4.00	3.18	0.82	5.77
		Whey	92.56	7.44	0.34	1.04	......	....	6.06	85.80	79.42	6.38	0.29	0.89	....	....	5.20
		Green cheese	40.20	59.80	33.87	21.90	......	....	4.03	14.20	5.71	8.49	4.81	3.11	....	....	0.57
125	Feb. 23	Milk	87.54	12.46	3.65	3.10	2.48	0.62	5.71	100	87.54	12.46	3.65	3.10	2.48	0.62	5.71
		Whey	93.09	6.91	0.30	0.84	......	....	5.77	89.16	83.00	6.16	0.27	0.75	....	....	5.14
		Green cheese	41.88	58.12	31.20	21.68	......	....	5.24	10.84	4.54	6.30	3.38	2.35	....	....	0.57
126	Feb. 24	Milk	85.37	14.63	5.00	3.99	3.14	0.85	5.64	100	85.37	14.63	5.00	3.99	3.14	0.85	5.64
		Whey	92.62	7.88	0.30	1.03	......	....	6.04	86.38	80.00	6.38	0.27	0.89	....	....	5.22
		Green cheese	39.43	60.57	34.73	22.76	......	....	3.08	13.62	5.37	8.25	4.73	3.10	....	....	0.42

I. Analyses of Milk, Whey and Cheese — (*Concluded*).

Number.	DATE.		COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							FROM ONE HUNDRED POUNDS OF MILK.							
			Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of casein.	Per cent. of albumen.	Per cent. of sugar, ash, etc.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of casein.	Pounds of albumen.	Pounds of sugar, ash, etc.
127	1893 Feb. 25	Milk	85.06	14.94	5.25	3.86	3.10	0.76	5.83	100	85.06	14.94	5.25	3.86	3.10	0.76	5.83
		Whey	92.74	7.26	0.36	1.04	......	....	5.86	86.47	80.19	6.28	0.31	0.90	....	....	5.07
		Green cheese	36.00	64.00	36.51	21.88	......	....	5.61	13.53	4.87	8.66	4.94	2.96	....	....	0.76
128	Feb. 27	Milk	85.37	14.63	5.10	3.94	3.12	0.82	5.59	100	85.37	14.63	5.10	3.94	3.12	0.82	5.59
		Whey	92.85	7.15	0.40	1.04	......	....	5.71	86.85	80.64	6.21	0.35	0.90	....	....	4.96
		Green cheese	36.00	64.00	36.12	23.12	......	....	4.76	13.15	4.73	8.42	4.75	4.04	....	....	0.63
129	Feb. 28	Milk	85.43	14.57	4.80	3.90	3.16	0.82	5.79	100	85.43	14 57	4.80	3.98	3.16	0.82	5.79
		Whey	92.66	7.34	0.30	1.05	......	....	5.99	86.40	80.06	6.34	0.26	0.91	....	....	5.17
		Green cheese	39.50	60.50	33.38	22.57	......	....	4.55	13.60	5.37	8.23	4.54	3.07	....	....	0.62
130	March 1	Milk	85.27	14.73	5.20	4.01	3.16	0.85	5.52	100	85.27	14.73	5.20	4.01	3.16	0.85	5.52
		Whey	92.72	7.28	0.40	1.06	......	....	5.82	86.18	79.91	6.27	0.34	0.91	....	....	5 02
		Green cheese	38.78	61.22	35.17	22.43	......	....	3.62	13.82	5.36	8.46	4.86	3.10	....	....	0.50
131	March 2	Milk	85.48	14.52	4.80	3.93	3.13	0.80	5.79	100	85.48	14.52	4.80	3.93	3.13	0.80	5.79
		Whey	92.73	7.27	0.35	1.09	......	....	5.83	86.54	80.25	6.29	0.30	0.94	....	....	5.05
		Green cheese	38.85	61.15	33.43	22.22	......	....	5.50	13.46	5.23	8.23	4.50	2.99	....	....	0.74
132	March 3	Milk	85.60	14.40	4.70	3.83	3.00	0.83	5.87	100	85.60	14.40	4.70	3.83	3.00	0.83	5.87
		Whey	92.75	7.25	0.30	1.07	......	....	5.88	86.90	80.60	6.30	0.26	0.93	....	....	5.11
		Green cheese	38.16	61.84	33.90	22.14	......	....	5.80	13.10	5.00	8.10	4.44	2.90	....	....	0.76
133	March 4	Milk	85.17	14.83	5.25	3.86	3.05	0.81	5.72	100	85.17	14.83	5.25	3.86	3.05	0.81	5.72
		Whey	92.81	7.19	0.33	1.06	......	....	5.80	86.37	80.16	6.21	0.29	0.92	....	....	5.00
		Green cheese	36.76	63.24	36.40	21.57	......	....	5.27	13.63	5.01	8.62	4.96	2.94	....	....	0.72
134	March 6	Milk	85.16	14.84	4.90	3.89	3.16	0.73	6.05	100	85.16	14.84	4.90	3.89	3.16	0.73	6.05
		Whey	92.53	7.47	0.36	1.06	......	....	6.05	87.18	80.67	6.51	0.31	0.92	....	....	5.28
		Green cheese	35.02	64.98	35.80	23.13	......	....	6.05	12.82	4.49	8.33	4.59	2.97	....	....	0.77

135	March 7	Milk	85.35	14.65	4.85	3.93	3.13	0.80	5.87	100	85.35	14.65	4.85	3.93	3.13	0.80	5.87
		Whey	92.72	7.28	0.39	1.02	......	....	5.87	86.87	80.55	6.32	0.34	0.89	....	....	5.08
		Green cheese	36.56	63.44	34.35	23.15	......	....	5.94	13.13	4.80	8.33	4.51	3.04	....	....	0.79
136	March 8	Milk	85.23	14.77	5.00	3.88	3.06	0.82	5.89	100	85.23	14.77	5.00	3.88	3.06	0.82	5.89
		Whey	92.65	7.35	0.36	1.04	......	....	5.95	86.60	80.23	6.37	0.31	0.90	....	....	5.16
		Green cheese	37.30	62.70	35.00	22.24	......	....	5.46	13.40	5.00	8.40	4.69	2.98	....	....	0.73
137	March 9	Milk	85.63	14.37	4.75	3.73	2.96	0.77	5.89	100	85.63	14.37	4.75	3.73	2.96	0.77	5.89
		Whey	92.92	7.08	0.23	0.97	......	....	5.88	87.20	81.03	6.17	0.20	0.85	....	....	5.12
		Green cheese	35.94	64.06	35.55	22.50	......	....	6.01	12.80	4.60	8.20	4.55	2.88	....	....	0.77
138	March 10	Milk	85.53	14.47	4.70	3.76	2.94	0.82	6.01	100	85.53	14.47	4.70	3.76	2.94	0.82	6.01
		Whey	92.83	7.17	0.32	1.01	......	....	5.84	87.10	80.85	6.25	0.28	0.88	....	....	5.09
		Green cheese	36.28	63.72	34.26	22.33	......	....	7.13	12.90	4.68	8.22	4.42	2.88	....	....	0.92
139	March 11	Milk	85.64	14.36	4.80	3.72	3.09	0.63	5.84	100	85.64	14.36	4.80	3.72	3.09	0.63	5.84
		Whey	92.85	7.15	0.26	1.01	......	....	5.88	87.35	81.10	6.25	0.23	0.88	....	....	5.14
		Green cheese	35.90	64.10	35.13	22.45	......	....	5.52	12.65	4.54	8.11	4.57	2.84	....	....	0.70
140	March 12	Milk	86.36	13.64	4.30	3.43	2.75	0.68	5.91	100	86.36	13.64	4.30	3.43	2.75	0.68	5.91
		Whey	92.94	7.06	0.35	0.91	......	....	5.80	88.82	82.55	6.27	0.31	0.81	....	....	5.15
		Green cheese	34.08	65.92	35.68	23.44	.....	....	6.80	11.18	3.81	7.37	3.99	2.62	....	....	0.76
141	March 13	Milk	85.83	14.17	4.65	3.65	2.99	0.66	5.87	100	85.83	14.17	4.65	3.65	2.99	0.66	5.87
		Whey	92.88	7.12	0.28	0.98	......	....	5.86	87.72	81.47	6.25	0.24	0.86	....	....	5.15
		Green cheese	35.50	64.50	35.90	22.72	......	....	5.88	12.28	4.36	7.92	4.41	2.79	....	....	0.72
142	March 14	Milk	86.25	13.75	4.40	3.60	2.88	0.72	5.75	100	86.25	13.75	4.46	3.60	2.88	0.72	5.75
		Whey	93.06	6.94	0.88	0.93	....	....	5.73	88.40	82.27	6.13	0.25	0.82	....	....	5.06
		Green cheese	34.31	65.69	35.78	23.96	......	....	5.95	11.60	3.98	7.62	4.15	2.78	....	....	0.69
143	March 15	Milk	86.42	13.58	4.20	3.49	2.76	0.73	5.89	100	86.42	13.58	4.20	3.49	2.76	0.73	5.89
		Whey	93.00	7.00	0.27	0.93	......	....	5.80	88.30	82.12	6.19	0.24	0.82	....	....	5.12
		Green cheese	36.75	63.25	33.85	22.82	......	....	6.58	11.70	4.30	7.40	3.96	2.67	....	....	0.77
144	March 16	Milk	85.74	14.26	4.75	3.76	3.06	0.70	5.75	100	85.74	14.26	4.75	3.76	3.06	0.70	5.75
		Whey	92.75	7.25	0.23	0.99	......	....	5.98	87.20	80.88	6.32	0.24	0.86	....	....	5.22
		Green cheese	38.00	62.00	35.23	22.66	......	....	4.11	12.80	4.86	7.94	4.51	2.90	....	....	0.53
145	March 16	Milk	87.22	12.78	3.85	3.24	2.60	0.64	5.69	100	87.22	12.78	3.85	3.24	2.60	0.64	5.69
		Whey	93.10	6.90	0.33	0.86	.....	....	5.71	90.25	84.02	6.23	0.30	0.78	....	....	5.15
		Green cheese	32.82	67.18	36.40	25.23	......	....	5.55	9.75	3.20	6.55	3.55	2.46	....	....	0.54
146	March 17	Milk	86.20	13.80	4.40	3.60	2.93	0.67	5.80	100	86.20	13.80	4.40	3.60	2.93	0.67	5.80
		Whey	92.85	7.15	0.26	0.96	......	....	5.93	88.12	81.82	6.30	0.23	0.85	....	....	5.22
		Green cheese	26.87	63.13	35.10	23.15	......	....	4.88	11.88	4.38	7.50	4.17	2.75	....	....	0.58
147	March 18	Milk	85.78	14.22	4.80	3.69	3.01	0.68	5.73	100	85.78	14.22	4.80	3.69	3.01	0.68	5.73
		Whey	92.86	7.14	0.20	0.96	......	....	5.98	87.15	80.93	6.22	0.17	0.84	....	....	5.21
		Green cheese	37.75	62.25	36.03	22.18	......	....	4.04	12.85	4.85	8.00	4.63	2.85	....	....	0.52

II. Tabulated Statement of the Principal Conditions of Manufacture.

NUMBER OF EXPERIMENT.	Date.	Kind of cheese made.	Pounds of milk used.	Pounds of green cheese made.	Temperature of milk when rennet was added.	Ounces of rennet extract used per 1,000 lbs. of milk.	Time required for milk to begin to thicken.	Time from adding rennet to cutting curd.	Temperature to which curd was heated after cutting, etc.	Time taken to heat to 98 degrees Fahr. or more.	Time from reaching required temperature to drawing whey.
	1893.				Deg. F.		Min.	Min.	Deg. F.	Min.	Min.
107..........	February 1	Stirred-curd.....	570	68.0	86	2	15	30	98	45	240
108..........	2	Stirred-curd.....	599	71.8	85	2	16	40	100	55	85
109..........	4	Stirred-curd.....	560	72.6	86	2	15	25	100	50	80
110..........	6	Stirred-curd.....	509	67.8	89	2	15	30	96	55	45
111..........	8	Stirred-curd. ...	845	94.7	86	2	11	31	100	37	56
112..........	9	Stirred-curd.....	640	73.4	86	2	20	45	99	43	80
113..........	10	Stirred-curd.....	640	73.6	87	2	16	28	100	48	60
114..........	11	Stirred-curd.....	692	78.9	85	2	13	27	100	57	53
115..........	13	Cheddar	906	105.4	86	2	15	31	98	47	53
116..........	14	Cheddar	623	71.2	87	2	15	25	98	60	85
117..........	15	Cheddar	623	71.1	85	2	14	30	98	55	85
118..........	16	Cheddar	583	77.2	85	2	15	30	100	52	46
119..........	17	Stirred-curd.....	661	75.5	85	2	22	38	99	58	44
120..........	18	Stirred-curd.....	646	73.9	86	2	25	60	98	60	80
121..........	21	Stirred-curd.....	414	53.0	85	2	15	49	98	43	104
122..........	22	Stirred-curd.....	460	51.1	85	2	11	25	98	34	130
123..........	22	Stirred-curd.....	400	56.0	85	2½	14	26	98	37	172
124..........	23	Stirred-curd.....	514	73.0	85	2½	11	25	98	34	130
125..........	23	Stirred-curd.....	284	30.8	85	2½	20	35	99	43	99

126		24	Cheddar	517	70.4	85	2½	12	22	98	39	103
127		25	Stirred-curd	522	70.6	86	2½	15	25	98	30	65
128		27	Cheddar	933	122.8	85	2½	10	15	98	50	77
129		28	Stirred-curd	561	76.3	86	2½	21	27	98	54	77
130	March	1	Stirred-curd	528	73.0	87	2	21	40	98	54	100
131		2	Stirred-curd	520	70.0	85	2	17	27	98	43	70
132		3	Stirred-curd	532	69.6	85	2	9	20	99	40	55
133		4	Stirred-curd	523	71.3	87	2	9	15	99	33	70
134		6	Cheddar	892	114.8	86	2	13	26	98	60	140
135		7	Cheddar	547	71.8	85	2	10	25	97	60	75
136		8	Cheddar	544	72.9	85	2	10	20	98	65	20
137		9	Cheddar	494	63.2	87	2	9	32	100	32	53
138		10	Cheddar	476	61.4	86	2	11	21	98	43	95
139		11	Cheddar	445	56.3	85	2	13	27	98	66	67
140		12	Cheddar	804	89.9	85	2	15	26	98	60	162
141		13	Cheddar	863	105.9	85	2	13	25	99	60	110
142		14	Stirred-curd	1,018	118.1	85	2	13	22	98	67	65
143		15	Stirred-curd	1,026	120.0	87	2	11	28	96	60	75
144		16	Cheddar	566	72.4	86	2	20	40	97	60	285
145		16	Cheddar	445	42.9	85	2	14	29	98	42	360
146		17	Stirred-curd	929	110.4	85	2	13	31	98	81	170
147		18	Stirred-curd	596	89.5	85	2	14	25	98	55	78

Statement of results.

1. The time required for the milk to begin to thicken after the addition of rennet varied from nine to twenty-five minutes, and averaged fifteen minutes.

2. The time from adding rennet to cutting curd varied from fifteen to sixty minutes, and averaged twenty-nine minutes.

3. The time required to heat to 98° F. after cutting and stirring curd varied from thirty to eighty-one minutes and averaged fifty minutes.

4. The time from reaching 98° to drawing whey varied from twenty to 360 minutes, and averaged 100 minutes.

In general, it can be said that the behavior of the milk rich in fat was in no way different from that of ordinary milk. No special precautions had to be observed. The curd was as firm as that made from average factory milk.

III. The Composition of the Milk Used.

In the accompanying table, the composition of milk is given for groups arranged according to the per cent of fat in the milk. The lowest, highest, and average results are given for each group and then the average of all.

TABLE SHOWING COMPOSITION OF MILK BY GROUPS.

GROUPS.	Number of samples in group.		Pounds of water in 100 lbs. of milk.	Pounds of solids in 100 lbs. of milk.	Pounds of fat in 100 lbs. of milk.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein in 100 lbs. of milk.	Pounds of albumen in 100 lbs. of milk.	Pounds of sugar, ash, etc., in 100 lbs. of milk.
I. Milk containing from 3.65 to 4.00 per cent. of fat.	3	Least	86.87	12.46	3.65	3.10	2.48	0.62	5.69
		Greatest..	87.54	13.13	3.90	3.39	2.77	0.64	5.84
		Average..	87.21	12.79	3.80	3.25	2.62	0.63	5.74
II. Milk containing from 4.00 to 4.25 per cent. of fat.	8	Least	86.42	13.25	4.10	3.23	2.44	0.64	5.67
		Greatest..	86.75	13.58	4.25	3.49	2.76	0.79	5.95
		Average..	86.63	13.37	4.16	3.36	2.65	0.71	5.85
III. Milk containing from 4.25 to 4.50 per cent. of fat.	8	Least	86.20	13.23	4.30	3.37	2.69	0.66	5.56
		Greatest..	86.77	13.80	4.50	3.77	3.00	0.80	5.91
		Average..	86.38	13.62	4.37	3.57	2.87	0.70	5.68
IV. Milk containing from 4.50 to 4.75 per cent. of fat.	7	Least	85.53	13.80	4.55	3.52	2.86	0.56	5.73
		Greatest..	86.20	14.47	4.75	3.83	3.06	0.83	6.01
		Average..	85.78	14.22	4.66	3.69	2.98	0.71	5.87
V. Milk containing from 4.75 to 5.00 per cent. of fat.	10	Least	85.16	14.22	4.80	3.69	3.01	0.63	5.73
		Greatest..	85.78	14.84	5.00	3.99	3.16	0.85	6.05
		Average..	85.44	14.56	4.87	3.88	3.11	0.77	5.81

TABLE SHOWING COMPOSITION OF MILK BY GROUPS — (*Concluded*).

GROUPS.	Number of samples in group.		Pounds of water in 100 lbs. of milk.	Pounds of solids in 100 lbs. of milk.	Pounds of fat in 100 lbs. of milk.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein in 100 lbs. of milk.	Pounds of albumen in 100 lbs. of milk.	Pounds of sugar, ash, etc., in 100 lbs. of milk.
VI. Milk containing from 5.00 to 5.25 per cent. of fat.	5	Least	85.06	14.63	5.10	3.86	3.05	0.76	5.52
		Greatest..	85.37	14.94	5.25	4.01	3.18	0.85	5.53
		Average..	85.20	14.80	5.18	3.93	3.12	0.81	5.69
Average of all..............	....	....	86.00	14.00	4.56	3.65	2.92	0.73	5.79

Statement of results.

1. Pounds of solids in 100 pounds of milk.

The amount of solids in 100 pounds of milk varied from 12.46 to 14.94 pounds, and averaged 14 pounds.

2. Pounds of fat in 100 pounds of milk.

The amount of fat in 100 pounds of milk varied from 3.65 to 5.25 pounds, and averaged 4.56 pounds.

3. Pounds of casein and albumen in 100 pounds of milk.

The amount of casein and albumen in 100 pounds of milk varied from 3.1 to 4.01 pounds, and averaged 3.65 pounds.

4. Pounds of casein in 100 pounds of milk.

The amount of casein in 100 pounds of milk varied from 2.44 to 3.18 pounds, and averaged 2.92 pounds.

5. Pounds of albumen in 100 pounds of milk.

The amount of albumen in 100 pounds of milk varied from 0.56 to 0.85 pounds, and averaged 0.73 pounds.

6. Pounds of sugar, ash, etc., in 100 pounds of milk.

The amount of sugar, ash, etc., in 100 pounds of milk varied from 5.52 to 6.05 pounds and averaged 5.79 pounds.

1. RELATION OF CASEIN TO ALBUMEN IN NORMAL MILK RICH IN FAT.

For a discussion of this subject in connection with the results of last season's work, the reader is referred to Bulletin No. 50, pp. 40–43.

TABLE SHOWING RELATION OF CASEIN TO ALBUMEN IN MILK.

NUMBER OF EXPERIMENT.	Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of albumen in 100 pounds of milk.	Pounds of casein for 100 pounds of casein and albumen together.	Pounds of albumen for 100 pounds of casein and albumen together.	Pounds of casein for one pound of albumen in milk.
125	3.10	2.48	0.62	80.00	20.00	4.00
145	3.24	2.60	0.64	80.25	19.75	4.06
111	3.39	2.77	0.62	81.73	18.27	4.47
112	3.41	2.75	0.66	80.64	19.36	4.17
118	3.23	2.44	0.79	75.55	24.45	3.09
122	3.28	2.64	0.64	80.50	19.50	4.13
116	3.32	2.55	0.77	76.80	23.20	3.31
113	3.47	2.75	0.72	79.25	20.75	3.82
117	3.30	2.59	0.71	78.50	21.50	3.65
143	3.49	2.76	0.73	79.08	20.92	3.78
114	3.38	2.68	0.70	79.30	20.70	3.83
108	3.77	2.97	0.80	78.78	21.22	3.70
115	3.46	2.78	0.68	80.35	19.65	4.10
120	3.37	2.69	0.68	79.82	20.18	3.96
140	3.43	2.75	0.68	80.17	19.83	4.05
142	3.60	2.88	0.72	80.00	20.00	4.00
146	3.60	2.93	0.67	81.40	18.60	4.37
110	3.68	3.00	0.68	81.52	18.48	4.41
109	3.62	2.96	0.66	81.77	18.23	4.48
107	3.62	3.06	0.56	84.53	15.47	5.46
119	3.52	2.86	0.66	81.25	18.75	4.33
141	3.65	2.99	0.66	81.92	17.18	4.53
132	3.83	3.00	0.83	78.33	21.67	3.60
138	3.76	2.94	0.82	78.20	21.80	3.60
137	3.73	2.96	0.77	79.35	20.65	3.84
144	3.76	3.06	0.70	81.38	18.62	4.37
129	3.98	3.16	0.82	79.40	20.60	3.85
131	3.93	3.13	0.80	80.40	19.60	3.90
139	3.72	3.09	0.63	83.06	16.94	4.90
147	3.69	3.01	0.68	81.60	18.40	4.42
123	3.93	3.13	0.80	80.40	19.60	3.90
135	3.93	3.13	0.80	80.40	19.60	3.90
121	3.86	3.08	0.78	80.00	20.00	4.00
134	3.89	3.16	0.73	81.23	18.77	4.33
126	3.99	3.14	0.85	78.70	21.30	3.70
136	3.88	3.06	0.82	78.86	21.14	3.73
124	4.00	3.18	0.82	79.50	20.50	3.88
128	3.94	3.12	0.82	79.20	20.80	3.80
130	4.01	3.16	0.85	78.80	21.20	3.72
127	3.86	3.10	0.76	80.30	19.70	4.08
133	3.86	3.05	0.81	79.00	21.00	3.76

TABULATED GENERAL SUMMARY.

	Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of albumen in 100 pounds of milk.	Pounds of casein for one pound of albumen in milk.
Least	3.10	2.44	0.56	3.09
Greatest	4.01	3.18	0.85	5.46
Average	3.65	2.92	0.73	4.00

Statement of results.

1. Pounds of casein in 100 pounds of milk.

There were from 2.44 to 3.18 pounds of casein in 100 pounds of milk, with an average of 2.92 pounds.

2. Pounds of albumen in 100 pounds of milk.

The amount of albumen in 100 pounds of milk varied from 0.56 to 0.85 pounds, and averaged 0.73 pounds.

3. Pounds of casein for one pound of albumen.

For each pound of albumen in the milk the casein varied from 3.09 to 5.46 pounds, and averaged four pounds.

The general results compared with those of last season appear to suggest that in milk richer in fat there is a larger proportion of casein relative to albumen than in milk less rich in fat; that in other words, in rich milk a larger proportion of the nitrogen compounds can be utilized for cheese-making. Further study is needed to confirm this statement, but our results are suggestive on this point.

2. RELATION OF FAT TO CASEIN IN NORMAL MILK RICH IN FAT.

For a discussion of this subject in connection with the results of last season's work, see Bulletin No. 50, pp. 43–49.

TABLE SHOWING RELATION OF FAT TO CASEIN IN NORMAL MILK.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of fat for one pound of casein in milk.
125	3.65	2.48	1.47
145	3.85	2.60	1.48
111	3.90	2.77	1.41
112	4.10	2.75	1.49
118	4.10	2.44	1.68
122	4.10	2.64	1.55
116	4.15	2.55	1.63
113	4.20	2.75	1.53
117	4.20	2.59	1.62
143	4.20	2.76	1.52
114	4.25	2.68	1.58
108	4.30	2.97	1.45
115	4.30	2.78	1.55
120	4.30	2.69	1.60
140	4.30	2.75	1.56
142	4.40	2.88	1.53
146	4.40	2.93	1.50
110	4.45	3.00	1.48
109	4.50	2.96	1.52
107	4.55	3.06	1.49
119	4.55	2.86	1.59
141	4.65	2.99	1.56
132	4.70	3.00	1.57
138	4.70	2.94	1.60
137	4.75	2.96	1.60
144	4.75	3.06	1.55
129	4.80	3.16	1.52
131	4.80	3.13	1.53
139	4.80	3.09	1.55
147	4.80	3.01	1.59
123	4.85	3.13	1.55
135	4.85	3.13	1.55
121	4.90	3.08	1.59
134	4.90	3.16	1.55
126	5.00	3.14	1.59
136	5.00	3.06	1.63
128	5.10	3.18	1.60
128	5.10	3.12	1.63
130	5.20	3.16	1.65
127	5.25	3.10	1.69
133	5.25	3.05	1.72

TABULATED GENERAL SUMMARY.

	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of fat for one pound of casein.
Least	3.65	2.44	1.41
Greatest	5.25	3.18	1.72
Average	4.56	2.92	1.56

Statement of results.

For each pound of casein in the milk, the amount of fat varied from 1.41 to 1.72 pounds, and averaged 1.56 pounds. As compared with the results of last season's work with milk varying in fat-content from 3.05 to 4.4 per cent, it shows a much closer agreement than might be anticipated. (See Bulletin No. 50, pp. 44-47.) Over eighty per cent of these results are within one-tenth of a pound of the average of last season's work.

IV. Composition of the Whey.

TABULATED SUMMARY, GIVING COMPOSITION OF WHEY.

	Pounds of water in 100 lbs. of whey.	Pounds of solids in 100 lbs. of whey.	Pounds of fat in 100 lbs. of whey.	Pounds of casein and albumen in 100 lbs. of whey.	Pounds of sugar, ash, etc., in 100 lbs. of whey.
Least	92.50	6.84	0.20	0.84	5.51
Greatest	93.16	7.50	0.56	1.09	6.27
Average	92.85	7.15	0.33	0.97	5.85

A comparison of these results with those secured last season shows very close agreement in fat, and fairly close uniformity in respect to the other constituents. (See Bulletin No. 50, p. 58.)

V. Composition of the Green Cheese.

We present below the composition of the cheese arranged in groups corresponding to the composition of the milk, as given above.

TABLE SHOWING COMPOSITION OF GREEN CHEESE.

GROUPS.		Pounds of water in 100 pounds of cheese.	Pounds of solids in 100 pounds of cheese.	Pounds of fat in 100 pounds of cheese.	Pounds of casein and albumen in 100 pounds of cheese.	Pounds of sugar, ash, etc., in 100 pounds of milk.
I. Cheese made from milk containing from 3.65 to 4.00 per cent of fat.	Least..........	32.82	58.12	31.13	21.13	5.24
	Greatest......	41.88	67.18	36.40	25.23	6.46
	Average.......	38.65	61.35	32.91	22.68	5.76
II. Cheese made from milk containing from 4.00 to 4.25 per cent of fat.	Least..........	36.75	51.78	28.90	18.80	4.08
	Greatest.......	48.22	63.25	34.91	23.22	6.58
	Average.......	39.36	60.64	33.42	22.14	5.08
III. Cheese made from milk containing from 4.25 to 4.50 per cent of fat.	Least..........	34.08	58.72	31.13	21.13	3.27
	Greatest.......	41.28	65.92	35.78	24.42	6.80
	Average.......	37.58	62.42	33.95	22.83	5.64
IV. Cheese made from milk containing from 4.50 to 4.75 per cent of fat.	Least..........	33.95	61.84	33.90	22.14	4.11
	Greatest.......	38.16	66.05	36.40	23.70	7.21
	Average.......	36.10	63.90	35.27	22.75	5.88
V. Cheese made from milk containing from 4.75 to 5.00 per cent of fat.	Least..........	35.02	59.80	32.71	22.18	3.08
	Greatest.......	40.20	64.98	36.13	23.15	6.05
	Average.......	37.90	62.10	34.60	22.54	4.96
VI. Cheese made from milk containing from 5.00 to 5.25 per cent of fat.	Least..........	36.00	59.80	33.87	21.57	3.62
	Greatest.......	40.20	64.00	36.51	23.12	5.61
	Average.......	37.55	62.45	35.61	22.18	4.66
Average of all..................	....	37.83	62.17	34.35	22.52	5.30

Statement of results.

1. Pounds of water in 100 pounds of green cheese.

The amount of water in 100 pounds of green cheese varied from 32.82 to 48.22 pounds, and averaged 37.83 pounds.

2. Pounds of fat in 100 pounds of green cheese.

The amount of fat in 100 pounds of green cheese varied from 28.9 to 36.51 pounds, and averaged 34.35 pounds.

3. Pounds of casein and albumen in 100 pounds of cheese.

The amount of casein and albumen in 100 pounds of cheese varied from 18.8 to 25.23 pounds, and averaged 22.52 pounds.

1. RELATION OF FAT TO CASEIN IN CHEESE MADE FROM NORMAL MILK RICH IN FAT.

For a discussion of this subject in connection with the results of last season's work, see Bulletin No. 50, pp. 63-65.

TABLE SHOWING RELATION OF FAT TO CASEIN IN CHEESE.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 pounds of milk.	Pounds of fat in 100 pounds of green cheese	Pounds of casein in 100 pounds of green cheese.	Pounds of fat for one pound of casein in cheese.
125	3.65	31.20	21.68	1.44
145	3.85	36.40	25.23	1.44
111	3.90	32.23	22.95	1.40
112	4.10	33.30	22.67	1.46
118	4.10	28.90	18.80	1.54
122	4.10	33.60	22.70	1.48
116	4.15	33.86	21.96	1.54
113	4.20	34.00	23.22	1.46
117	4.20	34.90	22.10	1.58
143	4.20	33.85	22.82	1.48
114	4.25	34.91	22.86	1.53
108	4.30	32.58	24.42	1.34
115	4.30	34.90	22.79	1.53
120	4.30	33.65	22 55	1.49
140	4.30	35.68	23.44	1.52
142	4.40	35.78	23.96	1.49
146	4.40	35.10	23.15	1.50
110	4.45	31.13	21.13	1.47
109	4.50	32.77	21.23	1.52
107	4.55	35.62	23.22	1.50
119	4.55	36.40	23.70	1.54
141	4.65	35.90	22.72	1.58
132	4.70	33.90	22.14	1.53
138	4.70	34.26	22.33	1.53
137	4.75	35.55	22.50	1.58
144	4.75	35.23	22.66	1.55
129	4.80	33.38	22.57	1.48
131	4.80	33.43	22.22	1.50
139	4.80	36.13	22.45	1.60
147	4.80	36.03	22.18	1.60
123	4.85	32.71	21.86	1.50
135	4.85	34.35	23.15	1.48
121	4.90	34.45	22.81	1.51
134	4.90	35.80	23.13	1.54
126	5.00	34.73	22.76	1.53
136	5.00	35.00	22.24	1.57
124	5.10	33.87	21.90	1.55
128	5.10	36.12	23.12	1.56
130	5.20	35.17	22.43	1.57
127	5.25	36.51	21.88	1.66
133	5.25	36.40	21.57	1.68

TABULATED GENERAL SUMMARY.

	Pounds of fat in 100 pounds of cheese.	Pounds of casein in 100 pounds of cheese.	Pounds of fat for one pound of casein in cheese.
Least	28.90	18.80	1.40
Greatest	36.51	25.23	1.68
Average	34.35	22.52	1.52

Statement of results.

For each pound of casein in the cheese, the amount of fat varied from 1.40 to 1.68 lbs. and averaged 1.52 lbs.

VI. Loss of Milk-Constituents in Cheese-Making.

Table showing amount of milk-solids lost and recovered in cheese-making.

NUMBER OF EXPERIMENT.	Pounds of solids in 100 lbs. of milk.	Pounds of milk-solids lost in whey for 100 lbs. of milk.	Pounds of milk-solids recovered in cheese for 100 lbs. of milk.	Per cent of milk-solids lost in whey.	Per cent of milk-solids recovered in cheese.
125.......	12.46	6.16	6.30	49.44	50.56
145.......	12.78	6.23	6.55	48.75	51.25
111.......	13.13	6.40	6.73	48.74	51.26
112.	13.46	6.36	7.10	48.25	52.75
118.......	13.25	6.39	6.86	48.23	51.77
122.......	13.33	6.58	6.75	49.36	50.64
116.......	13.26	6.27	6.99	47.28	52.72
113.......	13.56	6.40	7.16	47.20	52.80
117.......	13.25	6.18	7.07	46.64	53.36
143.......	13.58	6.18	7.40	45.50	54.50
114.......	13.30	6.23	7.07	46.85	53.15
108.......	13.68	6.10	7.58	44.60	55.40
115.......	13.33	6.24	7.09	46.81	53.19
120.......	13.23	6.17	7.06	46.63	53.37
140.......	13.64	6.27	7.37	46.00	54.00
142.......	13.75	6.13	7.62	44.60	55.40
146.......	13.80	6.30	7.50	45.65	54.35
110.......	13.77	5.96	7.81	43.30	56.70
109.......	13.76	5.95	7.81	43.24	56.76
107.......	14.10	6.22	7.88	44.10	55.90
119.......	13.80	6.36	7.44	46.10	53.90
141.......	14.17	6.25	7.92	44.10	55.90
132......	14.40	6.30	8.10	43.75	56.25
138.......	14.47	6.25	8.22	43.20	56.80
137.......	14.37	6.17	8.20	42.93	57.07
144.......	14.26	6.32	7.94	44.32	55.68
129.......	14.57	6.45	8.23	43.50	56.50
131.......	14.52	6.29	8.23	43.32	56.68
139.......	14.36	6.25	8.11	43.52	56.48
147.......	14.22	6.22	8.00	43.74	56.26
123.......	14.82	6.45	8.37	43.52	56.48
135.......	14.65	6.32	8.33	43.14	56.86
121.......	14.25	6.37	7.88	44.70	55.30
134.......	14.84	6.51	8.33	43.90	56.10
126.......	14.63	6.38	8.25	43.60	56.40
136.......	14.77	6.37	8.40	43.13	56.87
124.......	14.87	6.38	8.49	42.90	57.10
128.......	14.63	6.21	8.42	42.45	57.55
130.......	14.73	6.27	8.46	42.57	57.43
127.......	14.94	6.28	8.66	42.03	57.97
133.......	14.83	6.21	8.62	41.88	58.12

Statement of results.

1. Pounds of solids in 100 pounds of milk.

The solids in 100 pounds of milk varied from 12.46 to 14.94 pounds, and averaged nearly 14 pounds.

2. Pounds of solids lost in whey for 100 pounds of milk.

The amount of solids lost in whey varied from 5.95 to 6.58 pounds, and averaged 6.27 pounds.

3. Per cent of solids in milk lost in whey.

The per cent of solids in milk that was lost in whey varied from 41.88 to 49.44, and averaged 44.80.

It appears from these results, and from those secured last season, that the amount of milk solids lost for a hundred pounds of milk is fairly constant, being between 6 and 6.5 pounds. The amount of milk-solids recovered in cheese varied much more, ranging from 5.31 to 8.66 pounds for milk containing from 3 to 5.25 per cent of fat. It appears that when the milk-solids increase, the cheese-producing solids, the fat and casein, increase, while the whey-solids, the albumen, sugar and ash, increase very little in comparison. It, therefore, results that in rich milk a larger proportion of the solids is utilized in cheese-making than in the case of poorer milk; in other words, there is a smaller proportion of loss of milk solids in making rich milk into cheese.

TABLE SHOWING AMOUNT OF FAT RECOVERED AND LOST IN CHEESE-MAKING.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 lbs. of milk.	Pounds of fat lost in whey for 100 lbs. of milk.	Pounds of fat recovered in cheese for 100 lbs. of milk.	Per cent of fat in milk lost in whey.	Per cent of fat in milk recovered in cheese.
125......	3.65	0.27	3.38	7.40	92.60
145.......	3.85	0.30	3.55	7.80	92.20
111.......	3.90	0.31	3.59	7.95	92.05
112.......	4.10	0.28	3.82	6.83	93.17
118.......	4.10	0.27	3.83	6.59	93.41
122.......	4.10	0.37	3.73	9.02	90.98
116.......	4.15	0.28	3.87	6.75	93.25
113.......	4.20	0.29	3.91	6.90	93.10
117.......	4.20	0.22	3.98	5.24	94.76
143.......	4.20	0.24	3.96	5.70	94.30
114.......	4.25	0.27	3.98	6.35	93.65
108.......	4.30	0.39	3.91	9.07	90.93
115.......	4.30	0.24	4.06	5.58	94.42
120.......	4.30	0.45	3.85	10.47	89.53
140.......	4.30	0.31	3.99	7.20	92.80
142.......	4.40	0.25	4.15	5.68	94.52
146.......	4.40	0.23	4.17	5.23	94.77
110.......	4.45	0.31	4.14	6.97	93.03
109.......	4.50	0.24	4.26	5.55	94.45
107.......	4.55	0.30	4.25	6.60	93.40
119.......	4.55	0.39	4.16	8.57	91.43
141.......	4.65	0.24	4.41	5.16	94.84
132.......	4.70	0.26	4.44	5.53	94.47
138.......	4.70	0.28	4.42	5.96	94.04
137.......	4.75	0.20	4.55	5.20	95.80
144.......	4.75	0.24	4.51	5.05	94.95
129.......	4.80	0.26	4.54	5.40	94.60
131.......	4.80	0.30	4.50	6.25	93.75
139.......	4.80	0.23	4.57	4.80	95.20
147.......	4.80	0.17	4.63	3.54	96.46
123.......	4.85	0.27	4.58	5.57	94.43
135.......	4.85	0.34	4.51	7.00	93.00
121.......	4.90	0.49	4.41	10.00	90.00
134.......	4.90	0.31	4.59	6.32	93.68
126.......	5.00	0.27	4.73	5.40	94.60
136.......	5.00	0.31	4.69	6.20	93.80
124.......	5.10	0.29	4.81	5.70	94.30
128.......	5.10	0.35	4.75	6.86	93.14
130.......	5.20	0.34	4.86	6.54	93.46
127.......	5.25	0.31	4.94	5.90	94.10
133.......	5.25	0.29	4.96	5.52	94.48

Statement of results.

1. Pounds of fat in 100 pounds of milk.

The fat in the milk varied from 3.65 to 5.25 pounds in 100 pounds of milk and averaged 4.56 pounds.

2. Pounds of fat lost for 100 pounds of milk.

The amount of fat lost in the whey varied from 0.17 to 0.49 pounds and averaged 0.29 pounds for 100 pounds of milk.

3. Per cent of fat in milk lost in whey.

The per cent of fat in milk that was lost in the whey in the process of manufacture varied from 3.54 to 10 per cent, and averaged 6.36 per cent.

In general, there was every appearance of slight loss of fat in making cheese from the milk rich in fat; the whey was clear and the loss in press was exceedingly small. These indications were confirmed by the results of analysis. The general results of our last season's work are fully confirmed and all the facts secured go to show that milk rich in fat can be made into cheese with a smaller proportion of loss than milk less rich in fat.

TABLE SHOWING AMOUNT OF CASEIN AND ALBUMEN RECOVERED AND LOST IN CHEESE-MAKING.

NUMBER OF EXPERIMENT.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein and albumen lost in whey for 100 lbs. of milk.	Pounds of casein and albumen recovered in whey for 100 lbs. of milk.	Per cent of casein and albumen in milk lost in whey.	Per cent of casein and albumen in milk recovered in cheese.
125.......	3.10	0.75	2.35	24.19	75.81
145.......	3.24	0.78	2.46	34.07	75.93
111.......	3.39	0.82	2.57	24.19	75.81
112.......	3.41	0.81	2.60	23.75	76.25
118.......	3.23	0.74	2.48	22.91	77.09
122.......	3.28	0.76	2.52	23.17	76.83
116.......	3.32	0.81	2.51	24.40	75.60
113.......	3.47	0.80	2.67	23.05	76.95
117.......	3.30	0.78	2.52	23.64	76.36
143.......	3.49	0.82	2.67	23.47	76.53
114.......	3.38	0.78	2.60	23.06	76.84
108.......	3.77	0.84	2.93	22.28	77.72
115.......	3.46	0.81	2.69	23.41	76.59
120.......	3.37	0.79	2.58	23.44	76.56
140.......	3.43	0.81	2.62	23.63	76.37
142.......	3.60	0.82	2.78	22.78	77.22
146.......	3.60	0.85	2.75	23.61	76.39
110.......	3.68	0.87	2.81	23.64	76.36
109.......	3.62	0.86	2.76	23.76	76.24
107.......	3.62	0.85	2.77	23.48	76.52
119.......	3.52	0.81	2.71	23.00	77.00
141.......	3.65	0.86	2.79	23.56	76.44
132.......	3.83	0.93	2.90	24.28	75.72
138.......	3.76	0.88	2.88	23.40	76.60
137.......	3.73	0.85	2.88	22.80	77.20
144.......	3.76	0.86	2.90	22.87	77.13
129.......	3.98	0.91	3.07	22.86	77.14
131.......	3.93	0.94	2.98	23.92	76.08
139.......	3.72	0.88	2.84	23.65	76.35
147.......	3.69	0.84	2.85	22.76	77.24
123.......	3.93	0.87	3.06	22.14	77.86
135.......	3.93	0.89	3.04	22.65	77.35
121.......	3.86	0.94	2.92	24.35	75.65
134.......	3.89	0.92	2.97	23.65	76.35
126.......	3.99	0.89	3.10	22.30	77.70
136.......	3.88	0.90	2.98	23.20	76.80
124.......	4.00	0.89	3.11	22.25	77.75
128.......	3.94	0.90	4.04	22.84	77.16
130.......	4.01	0.91	3.10	22.70	77.30
127.......	3.86	0.90	2.96	23.32	76.68
133.......	3.86	0.92	2.84	23.83	76.17

Statement of results.

1. Pounds of casein and albumen in 100 pounds of milk.

The amount of casein and albumen varied from 3.10 to 4.01 pounds, and averaged 3.65 pounds in 100 pounds of milk.

2. Pounds of casein and albumen lost in whey for 100 pounds of milk.

The amount of casein and albumen lost in the whey varied from 0.74 to 0.94 pounds, and averaged 0.85 pounds in 100 pounds of milk.

3. Per cent of casein and albumen lost in whey.

The per cent of casein and albumen in milk that was lost in the whey varied from 22.14 to 24.4 per cent, and averaged 23.3 per cent.

It will be seen that the proportion of loss was very uniform and entirely within the limits of our last season's work with factory milk. All the facts thus far secured indicate that the proportion of casein and albumen lost in cheese making is apt to be somewhat less in rich than in poorer milk.

VII. Influence of Composition of Milk on Yield of Cheese.

Table showing relation of milk-constituents to yield of cheese.

NUMBER OF EXPERIMENTS.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of green cheese made from 100 pounds of milk.	Pounds of water in cheese made from 100 pounds of milk.	Pounds of fat in cheese made from 100 pounds of milk.	Pounds of casein in cheese made from 100 pounds of milk.	Pounds of sugar, ash, etc.
125	3.65	2.48	10.84	4.54	3.38	2.35	0.57
145	3.85	2.60	9.75	3.20	3.55	2.46	0.64
111	3.90	2.77	11.20	4.47	3.59	2.57	0.57
112	4.10	2.75	11.47	4.37	3.82	2.60	0.68
118	4.10	2.44	13.25	6.39	3.83	2.49	0.54
122	4.10	2.64	11.10	4.35	3.73	2.52	0.50
116	4.15	2.55	11.43	4.44	3.87	2.51	0.61
113	4.20	2.75	11.50	4.34	3.91	2.67	0.58
117	4.20	2.59	11.40	4.33	3.98	2.52	0.57
143	4.20	2.76	11.70	4.30	3.96	2.67	0.77
114	4.25	2.68	11.40	4.33	3.98	2.60	0.49
108	4.30	2.97	12.00	4.42	3.91	2.93	0.74
115	4.30	2.78	11.63	4.54	4.06	2.65	0.38
120	4.30	2.69	11.44	4.38	3.85	2.58	0.63
140	4.30	2.75	11.18	3.81	3.99	2.62	0.76
142	4.40	2.88	11.60	3.98	4.15	2.78	0.69
146	4.40	2.93	11.88	4.38	4.17	2.75	0.58
110	4.45	3.00	13.30	5.49	4.14	2.81	0.86
109	4.50	2.96	13.00	5.19	4.26	2.76	0.79
107	4.55	3.06	11.93	4.05	4.25	2.77	0.86
119	4.55	2.86	11.43	3.99	4.16	2.71	0.57
141	4.65	2.99	12.28	4.36	4.41	2.79	0.72
132	4.70	3.00	13.10	5.00	4.44	2.90	0.76
138	4.70	2.94	12.90	4.68	4.42	2.88	0.92
137	4.75	2.96	12.80	4.60	4.55	2.88	0.77
144	4.75	3.06	12.80	4.86	4.51	2.90	0.53
129	4.80	3.16	13.60	5.37	4.54	3.07	0.62
131	4.80	3.13	13.46	5.23	4.50	2.99	0.74
139	4.80	3.09	12.65	4.54	4.57	2.84	0.70
147	4.80	3.01	12.85	4.85	4.63	2.85	0.52
123	4.85	3.13	14.00	5.63	4.58	3.06	0.73
135	4.85	3.13	13.13	4.80	4.51	3.04	0.79
121	4.90	3.08	12.80	4.92	4.41	2.92	0.55
134	4.90	3.16	12.82	4.49	4.59	2.97	0.77
126	5.00	3.14	13.62	5.37	4.73	3.10	0.42
136	5.00	3.06	13.40	5.00	4.69	2.98	0.73
124	5.10	3.18	14.20	5.71	4.81	3.11	0.57
128	5.10	3.12	3.15	4.73	4.75	3.04	0.63
130	5.20	3.16	13.82	5.36	4.86	3.10	0.50
127	5.25	3.10	13.53	4.87	4.94	2.96	0.76
133	5.25	3.05	13.63	5.01	4.96	2.94	0.72

1. YIELD OF GREEN CHEESE FROM 100 POUNDS OF MILK.

The yield of green cheese from 100 pounds of milk varied from 9.75 to 14.2 pounds, and averaged 12.35 pounds.

2. AMOUNT OF WATER RETAINED IN CHEESE MADE FROM 100 POUNDS OF MILK.

The amount of water retained in the cheese made from 100 pounds of milk varied from 3.2 to 6.39 pounds, and averaged 4.7 pounds. The variation in amount of water retained in cheese is governed more or less by the composition of the milk; that is, the larger the amount of fat and casein in 100 pounds of milk, the larger will be the amount of water that the fat and casein will retain in the cheese; but serious variations are caused by difference in conditions of manufacture, and it is possible so to influence the amount of water retained in the cheese that the latter will have no definite relation to the composition of the milk. It is undoubtedly true that the fat and casein have a different capacity for retaining moisture, and the casein, naturally, under like conditions, will retain more moisture than the same amount of fat; but the results of our work do not suffice to show that the amount of water retained in the cheese bears any definite relation to the amount of casein in the cheese.

3. AMOUNT OF WATER RETAINED IN CHEESE MADE FROM 100 POUNDS OF MILK.

The amount of fat retained in the cheese made from 100 pounds of milk varied from 3.38 to 4.96 pounds, and averaged 4.27 pounds. When the fat in the milk increased, the amount of fat retained in the cheese very closely followed the increase of fat in the milk.

4. AMOUNT OF CASEIN RETAINED IN CHEESE MADE FROM 100 POUNDS OF MILK.

The amount of casein retained in 100 pounds of cheese varied from 2.35 to 3.11 pounds, and averaged 2.8 pounds.

5. RELATION OF FAT IN MILK TO YIELD OF CHEESE.

Table showing relation of fat in milk to yield of green cheese.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 lbs. of cheese.	Pounds of cheese made from 100 lbs. of milk.	Pounds of cheese from one pound of fat in milk.	Pounds of cheese containing 36.5 per cent. of water made from 100 lbs. of milk.	Pounds of cheese containing 36.5 per cent of water for 100 lbs. of fat in milk.
125	3.65	10.84	2.97	9.93	2.72
145	3.85	9.75	2.53	10.32	2.68
111	3.90	11.20	2.87	10.61	2.72
112	4.10	11.47	2.80	11.19	2.73
118	4.10	13.25	3.23	10.81	2.64
122	4.10	11.10	2.71	10.64	2.60
116	4.15	11.43	2.75	11.02	2.66
113	4.20	11.50	2.71	11.28	2.69
117	4.20	11.40	2.71	11.14	2.65
143	4.20	11.70	2.80	11.66	2.78
114	4.25	11.40	2.68	11.14	2.62
108	4.30	12.00	2.79	11.95	2.78
115	4.30	11.63	2.70	11.17	2.60
120	4.30	11.44	2.66	11.12	2.60
140	4.30	11.18	2.60	11.62	2.70
142	4.40	11.60	2.64	12.01	2.73
146	4.40	11.88	2.00	11.82	2.70
110	4.45	13.30	2.99	12.31	2.77
109	4.50	13.00	2.89	12.31	2.74
107	4.55	11.93	2.62	12.42	2.73
119	4.55	11.43	2.51	11.73	2.58
151	4.65	12.28	2.64	12.48	2.69
132	4.70	13.10	2.80	12.77	2.72
138	4.70	12.90	2.75	12.95	2.76
137	4.75	12.80	2.70	12.92	2.72
144	4.75	12.80	2.70	12.51	2.64
129	4.80	13.60	2.84	12.97	2.70
131	4.80	13.46	2.80	12.97	2.70
139	4.80	12.65	2.64	12.78	2.67
147	4.80	12.85	2.68	12.61	2.63
123	4.85	14.00	2.89	13.19	2.72
135	4.85	13.13	2.71	13.13	2.71
121	4.90	12.80	2.61	12.45	2.54
134	4.90	12.82	2.61	13.13	2.68
126	5.00	13.62	2.72	13.00	2.60
136	5.00	13.40	2.68	13.24	2.65
124	5.10	14.20	2.78	13.40	2.68
128	5.10	13.15	2.58	13.27	2.60
130	5.20	13.82	2.66	13.35	2.57
127	5.25	13.53	2.58	13.66	2.60
133	5.25	13.63	2.60	13.63	2.60

Statement of results.

The amount of cheese made for each pound of fat in milk varied from 2.53 to 3.23 pounds and averaged 2.71 pounds. If we calculate the yield for cheese containing the same amount of water (36.5 per cent) as the average of our last season's experiments, the yield varied from 2.54 to 2.78 pounds and averaged 2.65 pounds. Arranging the results contained in the above table by groups, we have the following table:

GROUPS.		Pounds of fat in 100 pounds of milk.	Pounds of cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.	Pounds of cheese containing 36.5 per cent of water made from 100 pounds of milk.	Pounds of cheese containing 36.5 per cent for one pound of fat in milk.
I. Milk containing from 3.65 to 4.00 per cent of fat.	Least ...	3.65	9.75	2.53	9.93	2.68
	Greatest.	3.90	11.20	2.97	10.61	2.72
	Average.	3.80	10.60	2.79	10.29	2.71
II. Milk containing from 4.00 to 4.25 per cent of fat.	Least ...	4.10	11.10	2.68	10.64	2.60
	Greatest.	4.25	13.25	3.23	11.66	2.78
	Average.	4.16	11.65	2.80	11.11	2.67
III. Milk containing from 4.25 to 4.50 per cent of fat.	Least ...	4.30	11.18	2.60	11.12	2.60
	Greatest.	4.50	13.30	2.99	12.31	2.78
	Average.	4.37	12.00	2.75	11.79	2.70
IV. Milk containing from 4.50 to 4.75 per cent of fat.	Least ...	4.55	11.43	2.51	11.73	2.58
	Greatest.	4.75	13.10	2.80	12.95	2.76
	Average.	4.66	12.46	2.67	12.54	2.69
V. Milk containing from 4.75 to 5.00 per cent of fat.	Least ...	4.80	12.65	2.61	12.61	2.54
	Greatest.	5.00	14.00	2.89	13.24	2.72
	Average.	4.87	13.23	2.72	12.94	2.66
VI. Milk containing from 5.00 to 5.25 per cent of fat.	Least ...	5.10	13.15	2.58	13.27	2.57
	Greatest.	5.25	14.20	2.78	13.66	2.68
	Average.	5.18	13.67	2.64	13.46	2.60

TABULATED SUMMARY OF RESULTS.

NUMBER OF EXPERIMENT.	Pounds of fat in 100 lbs. of milk.	Pounds of fat lost in whey for 100 lbs. of milk.	Per cent of fat in milk lost in whey.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein and albumen lost in whey for 100 lbs. of milk.	Per cent of casein and albumen in milk lost in whey.	Pounds of casein in 100 lbs. of milk.	Pounds of albumen in 100 lbs. of milk.	Pounds of casein for one pound of albumen in milk.	Pounds of fat for one pound of casein in milk.
125	3.65	0.27	7.40	3.10	0.75	24.19	2.48	0.62	4.00	1.47
145	3.85	0.30	7.80	3.24	0.78	24.07	2.60	0.64	4.00	1.48
111	3.90	0.31	7.95	3.39	0.82	24.19	2.77	0.62	4.47	1.41
112, 118, 122	4.10	0.31	7.56	3.31	0.77	23.26	2.61	0.70	3.73	1.57
116	4.15	0.28	6.75	3.32	0.81	24.40	2.55	0.77	3.31	1.63
113, 117, 143	4.20	0.25	5.95	3.42	0.82	23.98	2.70	0.72	3.75	1.55
114	4.25	0.27	6.35	3.38	0.78	23.06	2.68	0.70	3.83	1.58
108, 115, 120, 140	4.30	0.35	8.14	3.51	0.81	23.08	2.80	0.71	4.00	1.54
142, 146	4.40	0.24	5.45	3.60	0.83	23.05	2.90	0.70	4.14	1.52
110	4.45	0.31	6.97	3.68	0.87	23.64	3.00	0.68	4.41	1.48
109	4.50	0.24	5.55	3.62	0.86	23.76	2.96	0.66	4.48	1.52
107, 119	4.55	0.34	7.48	3.57	0.83	23.25	2.96	0.61	4.85	1.54
141	4.65	0.24	5.16	3.65	0.86	23.56	2.99	0.66	4.53	1.56
132, 138	4.70	0.27	5.75	3.80	0.88	23.16	2.97	0.83	3.58	1.58
137, 144	4.75	0.22	4.63	3.75	0.86	22.84	3.01	0.74	4.07	1.58
129, 131, 139, 147	4.80	0.24	5.00	3.83	0.89	23.24	3.10	0.73	4.25	1.55
123, 135	4.85	0.30	6.20	3.93	0.88	22.40	3.13	0.80	3.90	1.55
121, 134	4.90	0.40	8.16	3.88	0.93	23.97	3.12	0.76	4.10	1.57
126, 136	5.00	0.29	5.80	3.94	0.90	22.85	3.10	0.84	3.70	1.61
124, 128	5.10	0.32	6.27	3.97	0.90	22.67	3.15	0.82	3.84	1.62
130	5.20	0.34	6.54	4.01	0.91	22.70	3.16	0.85	3.72	1.65
127, 133	5.25	0.30	5.71	3.86	0.91	23.60	3.08	0.78	3.95	1.70

Tabulated Summary of Results — (*Concluded*).

Number of experiments.	Pounds of fat in 100 pounds of green cheese.	Pounds of casein in 100 pounds of green cheese.	Pounds of water in 100 pounds of green cheese.	Pounds of fat for one pound of casein in cheese.	Pounds of green cheese made from 100 pounds of milk.	Pounds of water in cheese from 100 pounds of milk.	Pounds of fat in cheese from 100 pounds of milk.	Pounds of casein in cheese from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.	Pounds of milk required to make one pound of cheese.
125	31.20	21.68	41.88	1.44	10.84	4.54	3.38	2.35	2.87	9.23
145	36.40	25.23	32.82	1.44	9.75	3.20	3.55	2.46	2.53	10.25
111	32.23	22.95	39.90	1.40	11.20	4.47	3.59	2.57	2.87	8.93
112, 118, 122	31.93	21.39	41.84	1.49	11.94	5.04	3.79	2.54	2.91	8.37
116	33.86	21.96	38.85	1.54	11.43	4.44	3.87	2.51	2.75	8.76
113, 117, 143	34.25	22.71	37.50	1.51	11.53	4.32	3.95	2.62	2.75	8.69
114	34.91	22.86	38.00	1.53	11.40	4.33	3.98	2.60	2.68	8.77
108, 115, 120, 140	34.20	23.30	27.06	1.46	11.56	4.29	3.95	2.70	2.69	8.65
142, 146	35.44	23.55	35.09	1.50	11.74	4.18	4.16	2.77	2.67	8.52
110	31.13	21.13	41.28	1.47	13.30	5.49	4.14	2.81	2.99	7.52
109	32.77	21.23	39.92	1.52	13.00	5.19	4.26	2.76	2.89	7.70
107, 119	36.00	23.46	34.45	1.52	11.68	4.02	4.20	2.74	2.57	8.56
141	35.90	22.72	35.60	1.58	12.28	4.36	4.41	2.79	2.64	8.14
132, 138	34.08	22.24	37.22	1.53	13.00	4.84	4.43	2.89	2.77	7.70
137, 144	35.39	22.58	36.97	1.57	12.80	4.73	4.53	2.89	2.70	7.81
129, 131, 139, 147	34.74	22.36	38.00	1.55	13.14	5.00	4.56	2.94	2.74	7.61
123, 135	33.53	22.50	38.38	1.49	13.56	5.22	4.55	3.05	2.80	7.37
121, 134	35.12	22.97	36.73	1.52	12.81	4.70	4.50	2.95	2.61	7.80
126, 136	34.87	22.50	38.37	1.55	13.51	5.19	4.71	3.04	2.70	7.40
124, 128	35.00	22.51	38.10	1.56	13.68	5.22	4.78	3.08	2.68	7.31
130	35.17	22.43	38.78	1.57	13.82	5.36	4.86	3.10	2.66	7.25
127, 133	36.45	21.72	36.38	1.67	13.58	4.94	4.95	2.59	2.59	7.35

VIII. General Summary of the Results of Experiments in the Manufacture of Cheese, from Normal Milk, Rich in Fat.

1. THE COMPOSITION OF NORMAL MILK, RICH IN FAT.

1. *Pounds of solids in* 100 *pounds of milk.*

The milk-solids in 100 pounds of milk varied from 12.46 to 14.94 pounds, and averaged 14 pounds.

2. *Pounds of fat in* 100 *pounds of milk.*

The fat in 100 pounds of milk varied from 3.65 to 5.25 pounds, and averaged 4.56 pounds.

3. *Pounds of casein and albumen in* 100 *pounds of milk.*

The casein and albumen in 100 pounds of milk varied from 3.1 to 4.01 pounds, and averaged 3.65 pounds.

4. *Pounds of casein in* 100 *pounds of milk.*

The casein in 100 pounds of milk varied from 2.44 to 3.18 pounds, and averaged 2.92 pounds.

5. *Pounds of albumen in* 100 *pounds of milk.*

The albumen in 100 pounds of milk varied from 0.56 to 0.85 pounds, and averaged 0.73 pounds.

6. *Relation of casein to albumen in normal milk.*

For each pound of albumen in the milk, the casein varied from 3.09 to 5.46 pounds, and averaged 4 pounds.

7. *Relation of fat to casein in normal milk.*

For each pound of casein in the milk, the fat varied from 1.41 to 1.72 pounds, and averaged 1.56 pounds.

2. THE COMPOSITION OF WHEY.

1. *Pounds of solids in* 100 *pounds of whey.*

The amount of solids in 100 pounds of whey varied from 6.84 to 7.5 pounds, and averaged 7.15 pounds.

2. *Pounds of fat in* 100 *pounds of whey.*

The amount of fat in 100 pounds of whey varied from 0.2 to 0.56 pounds, and averaged 0.33 pounds.

3. *Pounds of casein and albumen in* 100 *pounds of whey.*

The amount of casein and albumen in 100 pounds of whey varied from 0.84 to 1.09 pounds, and averaged 0.97 pounds.

3. The Composition of Green Cheese Made from Normal Milk.

1. *Pounds of water in* 100 *pounds of green cheese.*

The amount of water in 100 pounds of green cheese varied from 32.82 to 48.22 pounds, and averaged 37.83 pounds. It was the most variable constituent of the cheese.

2. *Pounds of fat in* 100 *pounds of green cheese.*

The amount of fat in 100 pounds of green cheese varied from 28.9 to 36.51 pounds, and averaged 34.35 pounds.

3. *Pounds of casein in* 100 *pounds of green cheese.*

The amount of casein in 100 pounds of green cheese varied from 18.8 to 25.23 pounds, and averaged 22.52 pounds.

4. *Relation of fat to casein in cheese.*

For each pound of casein in the cheese, the amount of fat varied from 1.4 to 1.68 pounds, and averaged 1.52 pounds.

4. Loss of Milk-Constituents in Cheese-Making.

1. *Loss of milk-solids in cheese-making.*

a. The amount of milk-solids in 100 pounds of milk that was lost in the whey in cheese making varied from 5.95 to 658 pounds, and averaged 6.27 pounds; this was equivalent to from 41.88 to 49.44 per cent of the solids in the milk, with an average of 44.8 per cent.

b. The per cent of solids in the milk lost in the whey diminished as the fat increased.

2. *Loss of fat in cheese-making.*

a. The amount of fat in 100 pounds of milk that was lost in the whey in cheese-making varied from 0.17 to 0.49 pounds, and averaged 0.29 pounds (nearly 5 ounces); this was equivalent to from 3.54 to 10 per cent of the fat in milk, with an average of 6.36 per cent.

b. The proportion of fat in milk that was lost in cheese-making was entirely independent of the amount of fat in the milk. The variations in loss were due either to the condition of the milk or to some special conditions employed in manufacture.

3. *Loss of casein and albumen in cheese-making.*

a. The amount of casein and albumen in 100 pounds of milk that was lost in the whey in cheese-making varied from 0.74 to 0.94 pounds, and averaged 0.85 pounds; this was equivalent to from 22.14 to 24.4 per cent of the casein and albumen in the milk, with an average of 23.3 per cent.

b. The proportion of casein and albumen lost in cheese-making was, in general, very uniform and was little influenced by variation in the conditions of manufacture.

5. INFLUENCE OF COMPOSITION OF MILK ON YIELD OF CHEESE.

1. *Yield of green cheese from* 100 *pounds of milk.*

From 100 pounds of milk there were made from 9.75 to 14.2 pounds of green cheese, the average being 12.35 pounds.

2. *Pounds of milk required to make one pound of cheese.*

There were from 7.04 to 10.25 pounds of milk required to make one pound of cheese, 8.1 pounds being the average.

3. *Amount of water retained in cheese made from* 100 *pounds of milk.*

The amount of water retained in the cheese made from 100 pounds of milk varied from 3.2 to 6.39 pounds, and averaged 4.7 pounds.

4. *Amount of fat retained in cheese made from* 100 *pounds of milk.*

The amount of fat retained in cheese made from 100 pounds of milk varied from 3.38 to 4.96 pounds, and averaged 4.27 pounds. The variation in the amount of fat retained in the cheese made from 100 pounds of milk followed very closely the variation of fat in 100 pounds of milk.

5. *Amount of casein and albumen retained in cheese made from* 100 *pounds of milk.*

The amount of casein and albumen retained in the cheese made from 100 pounds of milk varied from 2.35 to 3.11 pounds, and averaged 2.8 pounds.

6. *Relation of fat in milk to yield of green cheese.*

Each pound of fat produced from 3.53 to 2.23 pounds of cheese, the average being 2.71 pounds.

IX. CHARACTER AND EXTENT OF INVESTIGATION MADE IN RELATION TO THE MANUFACTURE OF CHEESE IN CHEESE-FACTORIES DURING THE SEASON OF 1893.

This station began its investigation relating to the manufacture of cheese in September, 1891, making eight preliminary experiments at the station and one at a cheese-factory. The investigation was continued through the season of 1892, the work being divided between the station and various cheese-factories. In February and March, of 1893, some additional experiments were carried on at the station.

In connection with the investigation carried on during the season of 1892, there were brought out some highly important results that were altogether new and unexpected. In order to confirm or modify these and some other results, it was decided to confine the investigation during the factory season of 1893 to fewer lines than in 1892, but to make the work on the selected lines more extensive. The object of this season's work has, therefore, been to study, (1) the composition of normal factory milk, of whey and of cheese; (2) the conditions of manufacture, as found in actual practice; (3) the losses of milk constituents; and (4) the relations existing between the composition of milk and the composition and yield of the resulting cheese. The entire work has been confined to commercial operations carried on in cheese-factories, and to the study of normal factory milk and of cheese made from normal factory milk.

It is designed to make this summary as complete in itself as possible, so that reference to previous bulletins will be necessary only when the details of individual results are desired. Such detailed results of the season's work of 1893 have been published in Bulletins 60, 61, 62 and 65. For the sake of comparison, the summarized results of the factory-work done during the factory season of 1892 will be presented.

In Bulletin 37, in which were given the results of our first nine preliminary experiments in cheese-making, begun in the fall of 1891, we made the following statement: "While, in most respects, fairly definite results were obtained, it must be kept in mind that the experiments so far are few in number and can scarcely justify any broad conclusions. The results of this first series of experiments should be looked upon mainly as valuable suggestions for future work; and, if the results of several series of investigations, made under varying conditions, agree, then we may be able to state definite general conclusions, which may be regarded as established facts." The results of the work done during the seasons of 1892 and 1893 have fully justified the caution contained in the above statement. Some of the results of our first experiments have been confirmed, while others have been greatly modified by our later, more extended investigations. However, it will be noticed later that the results secured in the extended work of 1892, and in the much more extensive work of 1893, show remarkable agreement; and we, therefore, are warranted in making some statements with definite positiveness, feeling that many of our results must be regarded as so conclusive that further work in these lines can only more fully confirm the results already secured by us.

Our investigation has included over 250 experiments relating to the manufacture of American cheese and over 150 of these have been confined to cheese factories.

NOTE.— The results of the work done by this station in relation to the manufacture of cheese have been published in Bulletins 37, 43, 45, 46, 47, 50, 54, 56, 60, 61, 62, 63 and 65, containing in all over 900 pages.

1. POINTS INVESTIGATED.

1. The conditions of manufacture as found at factories.
2. The composition of normal factory milk in New York State.
    - *a.* Milk solids.
    - *b.* Fat.
    - *c.* Casein.
    - *d.* Albumen.
    - *e.* Relation of fat to casein.
    - *f.* Relation of casein to albumen.
3. The composition of whey.

4. The composition of green cheese.
    - *a.* Water.
    - *b.* Fat.
    - *c.* Casein.
    - *d.* Relation of fat to casein.
    - *e.* Relation of fat to other solids.
5. Loss of milk constituents in cheese-making.
    - *a.* Solids.
    - *b.* Fat.
    - *c.* Casein and albumen.
6. Influence of composition of milk on composition of cheese.
    - *a.* Fat.
    - *b.* Casein.
7. Influence of composition of milk on yield of cheese.
    - *a.* Fat.
    - *b.* Casein.

8. Influence of advancing lactation and of season upon the composition of the milk, yield of cheese, etc., during the factory season.

2. EXTENT OF INVESTIGATION.

The results secured during the season of 1893 represent the work of 100 days between April 12 and October 31. This work was done at 50 different factories which were located in 8 different counties — Cayuga, Herkimer, Jefferson, Lewis, Madison, Oneida, Oswego and St. Lawrence. These are among our largest cheese-producing counties, excepting Cayuga, as is shown by the fact that the other seven counties produced in 1892 over sixty per cent of the entire cheese product of our State, according to the census report of our State Department of Agriculture. The work done was distributed as follows: 20 days at the No. 1 factory of E. L. Stone, at Mannsville, between April 17 and September 11; 25 days at the factory of G. Merry, Verona, N. Y., between April 12 and October 1; and 55 days at 48 other factories between April 13 and October 31. The study of milk was continued through October at the factories of both Mr. Stone and Mr. Merry. In this work there have been used about 750,000 pounds of milk, representing the average of not less than 5,00,0000 pounds of milk and the product of over 15,000 cows. The cows were very largely natives, though there were many grades and a few thoroughbreds.

3. NUMBER OF DAYS' WORK DONE AT FACTORIES DURING THE SEASONS OF 1892–3.

	April.	May.	June.	July.	August.	September.	October.	Total for season.
1892–3	......	6	10	8	7	11	8	50
Stone's factory	2	3	4	5	4	2	......	20
Merry's factory	3	5	4	4	5	4	......	25
Forty-eight factories	4	16	12	8	6	2	7	55
Total	9	30	30	25	22	19	15	150

4. Pounds of Milk Used in Work.

1892.	April.	May.	June.	July.	August.	September.	October.	Total for season.
Least	......	3,307	4,394	4,083	3,712	3,758	2,903	....
Greatest	......	3,583	4,640	5,097	4,322	4,159	3,749	....
Average	......	3,429	4,509	4,591	4,050	3,994	3,240	....
Total	......	20,573	45,058	36,726	28,348	43,932	25,917	200,554
1893, Stone's factory:								
Least	5,110	9,053	14,370	10,343	6,705	6,422	......	....
Greatest	5,615	13,543	15,596	14,672	8,603	6,924	......	....
Average	5,363	11,720	15,118	12,524	7,613	6,673	......	....
Total	10,725	35,161	60,472	62,618	30,452	13,346	......	212,774
1893, Merry's factory:								
Least	2,693	6,852	14,621	11,724	8,832	8,944	......	....
Greatest	5,491	13,789	15,142	13,351	11,095	10,244	......	....
Average	4,039	10,643	14,811	12,473	9,779	9,670	......	....
Total	12,119	53,217	59,244	49,893	48,895	38,681	......	262,049
1893, 48 factories:								
Least	2,619	843	2,696	3,798	2,702	5,986	2,400	....
Greatest	3,769	11,378	12,263	7,015	6,428	6,558	5,393	....
Average	3,004	5,037	5,246	5,360	4,622	6,272	3,622	....
Total	12,016	80,588	62,958	42,879	27,733	12,544	25,332	264,050
Total for 1893	34,860	168,966	182,674	155,390	107,080	64,571	25,332	738,873
Total for 1892–3	34,860	189,539	227,732	192,116	135,428	108,503	51,249	939,427

5. POUNDS OF CHEESE MADE IN WORK.

1892.	April.	May.	June.	July.	August.	September.	October.	Total for season.
Least	......	292	403	396	378	383	362	......
Greatest	......	306	513	516	437	409	427	......
Average	......	300	447	457	406	396	383	......
Total	......	1,801	4,467	3,658	2,843	4,353	3,064	20,185
1893, Stone's factory:								
Least	500	838	1,410	1,020	702	691	......	......
Greatest	511	1,379	1,538	1,412	888	710	......	......
Average	505	1,154	1,480	1,231	771	700	......	......
Total	1,011	3,461	5,919	6,157	3,083	1,401	......	21,032
1893, Merry's factory:								
Least	242	624	1,420	1,113	913	1,000	......	......
Greatest	505	1,389	1,494	1,272	1,090	1,063	......	......
Average	373	1,036	1,455	1,196	977	1,033	......	......
Total	1,118	5,179	5,822	4,784	4,885	4,132	......	25,920
1893, 48 factories:								
Least	239	87	253	385	286	660	293	......
Greatest	356	1,144	1,224	672	810	741	610	......
Average	280	504	530	530	484	700	425	......
Total	1,122	8,062	6,350	4,242	2,905	1,401	2,973	27,055
Total for 1893	3,251	16,702	18,091	15,183	10,873	6,934	2,973	74,007
Total for 1892–3	3,251	18,503	22,558	18,841	13,716	11,287	6,037	94,192

6. AMOUNT OF ANALYTICAL WORK REQUIRED BY THE INVESTIGATION AND EXTENT OF DATA FURNISHED.

In order to insure the greatest possible accuracy, every analytical determination was performed three times, so that in making analyses of the milk used in 100 experiments, an amount of analytical work was done that was equivalent to the analysis of 300 samples of milk. The same was true of the whey and cheese. The table below gives the number of different determinations as as they were made each month.

1893.	April.	May.	June.	July.	August.	September.	October.	Total for season.
Total solids	135	360	300	255	225	120	144	1,539
Fat	135	360	300	255	225	120	144	1,539
Casein and albumen	135	360	300	255	225	120	144	1,539
Casein	81	216	180	153	135	72	102	939
Total number of direct determinations.	486	1,396	1,080	918	810	432	534	5,556
Water	45	120	100	85	75	40	48	513
Albumen	45	120	100	85	75	40	48	513
Sugar, ash, etc	45	120	100	85	75	40	48	513
Total number of indirect determinations	135	360	300	255	225	120	144	1,539
Total number of direct and indirect determinations	621	1,656	1,380	1,173	1,035	552	678	7,095

In addition to the numerical data furnished directly by chemical analysis, there have been presented other data derived from these, the presentation of which was required for an intelligent discussion of the various points to which attention was called. These derived numerical data aggregate several thousand in number.

Still further, various data have been presented in regard to the conditions of manufacture, and these have amounted to about 1,600 in number. These numbers serve to indicate, to some extent, the very large amount of detailed work that this investigation has necessitated.

7. EXPLANATION CONNECTED WITH THE FOLLOWING TABLE CONTAINING ANALYSES OF MILK, WHEY AND CHEESE.

The analyses contained in the following table are arranged in the order of months and weeks. Each analysis represents the average of all the different milks that were used in our work during that one week in that particular month. Thus, commencing with the second week in April, we have each week of each month represented in unbroken succession during the season through October. Each average represents from two to twelve separate analyses. The amount of whey and the composition of the cheese were obtained by the method adopted in Bulletin No. 50, and since used in our succeeding work.

X. TABULATED AVERAGES OF ANALYSES OF MILK, WHEY AND CHEESE.

DATE.		COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							FROM ONE HUNDRED POUNDS OF MILK.							
		Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of casein.	Per cent. of albumen.	Per cent. of sugar, ash, etc.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of casein.	Pounds of albumen.	Pounds of sugar, ash, etc.
1893. April, second week	Milk	88.00	12.00	3.43	2.87	2.34	0.53	5.70	100	88.00	12.00	3.43	2.87	2.34	0.53	5.70
	Whey	93.17	6.83	0.33	0.76	......	.. .	5.74	99.62	84.43	6.19	0.30	0.69	....	....	5.20
	Green cheese	38.06	61.94	33.37	23.24	......	....	5.33	9.38	3.57	5.81	3.13	2.18	....	....	0.50
April, third week	Milk	87.94	12.06	3.47	2.80	2.30	0.50	5.79	100	87.94	12.06	3.47	2.80	2.30	0.50	5.79
	Whey	93.11	6.89	0.44	0.74	......	....	5.71	90.64	84.39	6.25	0.40	0.67	....	....	5.18
	Green cheese	37.93	62.07	32.80	22.75	......	....	6.52	9.36	3.55	5.81	3.07	2.13	....	....	0.61
April, fourth week	Milk	88.11	11.89	3.40	2.78	2.24	0.54	5.71	100	88.11	11.89	3.40	2.78	2.24	0.54	5.71
	Whey	93.22	6.78	0.40	0.70	......	....	5.68	90.74	84.59	6.15	0.36	0.64	....	....	5.15
	Green cheese	38.01	61.99	32.83	23.11	......	....	6.05	9.26	3.52	5.74	3.04	2.14	....	....	0.56
May, first week	Milk	87.91	12.09	3.46	2.81	2.23	0.58	5.82	100	87.91	12.09	3.46	2.81	2.23	0.58	5.82
	Whey	93.10	6.90	0.40	0.74	......	....	5.76	90.28	84.05	6.23	0.36	0.67	....	....	5.20
	Green cheese	39.70	60.30	31.90	22.02	......	....	6.38	9.72	3.86	5.86	3.10	2.14	....	....	0.62
May, second week	Milk	87.84	12.16	3.46	2.90	2.27	0.63	5.80	100	87.84	12.16	3.46	2.90	2.27	0.63	5.80
	Whey	93.05	6.95	0.38	0.80	......	....	5.77	90.59	84.29	6.30	0.34	0.73	....	....	5.23
	Green cheese	37.73	62.27	33.16	33.06	......	....	6.05	9.41	3.55	5.86	3.12	2.17	....	....	0.57
May, third week	Milk	87.61	12.39	3.60	3.03	2.34	0.69	5.76	100	87.61	12.39	3.60	3.03	2.34	0.69	5.76
	Whey	93.04	6.96	0.42	0.81	......	....	5.73	90.56	84.26	6.30	0.38	0.73	....	....	5.19
	Green cheese	35.49	64.51	34.11	24.36	......	....	6.04	9.44	3.35	6.09	3.22	2.30	....	....	0.57
May, fourth week	Milk	87.11	12.89	3.81	3.31	2.56	0.75	5.77	100	87.11	12.89	3.81	3.31	2.56	0.75	5.77
	Whey	92.92	7.08	0.41	0.91	......	....	5.76	89.70	83.35	6.35	0.37	0.82	....	....	5.16
	Green cheese	36.50	63.50	33.40	24.18	......	....	5.92	10.30	3.76	6.54	3.44	2.49	....	....	0.61
June, first week	Milk	87.26	12.74	3.67	3.26	2.48	0.78	5.81	100	87.26	12.74	3.67	3.26	2.48	0.78	5.81
	Whey	92.98	7.02	0.34	0.89	......	....	5.79	90.03	83.71	6.32	0.31	0.80	....	....	5.21
	Green cheese	35.61	64.39	33.70	24.68	......	....	6.01	9.97	3.55	6.42	3.36	2.46	....	....	0.60

June, second week	Milk	87.44	12.56	3.53	3.24	2.49	0.75	5.79	100	87.44	12.56	3.53	3.24	2.49	0.75	5.79
	Whey	92.96	7.04	0.36	0.88	......	....	5.80	90.40	84.04	6.36	0.33	0.80	....	....	5.23
	Green cheese	35.42	64.58	33.33	25.42	......	....	5.83	9.60	3.40	6.20	3.20	2.44	....	....	0.56
June, third week	Milk	87.22	12.78	3.73	3.24	2.48	0.76	5.81	100	87.22	12.78	3.73	3.24	2.48	0.76	5.81
	Whey	92.95	7.05	0.35	0.90	......	....	5.80	89.95	83.61	6.34	0.31	0.81	....	....	5.22
	Green cheese	35.92	64.08	34.03	24.18	......	....	5.87	10.05	3.61	6.44	3.42	2.43	....	....	0.59
June, fourth week	Milk	87.38	12.62	3.63	3.20	2.47	0.73	5.79	100	87.38	12.62	3.63	3.20	2.47	0.73	5.79
	Whey	93.05	6.95	0.27	0.87	......	....	5.81	89.98	83.73	6.25	0.24	0.78	....	....	5.23
	Green cheese	36.43	63.57	33.83	24.15	......	....	5.59	10.02	3.65	6.37	3.39	2.42	....	....	0.56
July, first week	Milk	87.53	12.47	3.50	3.10	2.41	0.69	5.87	100	87.53	12.47	3.50	3.10	2.41	0.69	5.87
	Whey	92.98	7.02	0.31	0.83	......	....	5.88	90.42	84.07	6.35	0.28	0.75	....	....	5.32
	Green cheese	36.12	63.88	33.61	24.53	......	....	5.74	9.58	3.46	6.12	3.22	2.35	....	....	0.55
July, second week	Milk	87.52	12.48	3.60	3.08	2.40	0.68	5.80	100	87.52	12.48	3.60	3.08	2.40	0.68	5.80
	Whey	93.08	6.92	0.35	0.81	......	....	5.76	90.22	83.98	6.24	0.32	0.73	....	....	5.19
	Green cheese	36.20	63.80	33.54	24.03	......	....	6.23	9.78	3.54	6.24	3.28	2.35	....	....	0.61
July, third week	Milk	87.49	12.51	3.64	3.09	2.39	0.70	5.78	100	87.49	12.51	3.64	3.09	2.39	0.70	5.78
	Whey	93.01	6.99	0.37	0.85	......	....	5.77	90.05	83.76	6.29	3.33	0.77	....	....	5.19
	Green cheese	37.49	62.51	33.27	23.32	......	....	5.92	9.95	3.73	6.22	3.31	2.32	....	....	0.59
July, fourth week	Milk	87.58	12.42	3.65	2.99	2.33	0.66	5.78	100	87.58	12.42	3.65	2.99	2.33	0.66	5.78
	Whey	93.06	6.94	0.38	0.79	......	....	5.77	90.26	84.00	6.26	0.34	0.71	....	....	5.21
	Green cheese	36.76	63.24	34.00	23.40	......	....	5.84	9.74	3.58	6.16	3.31	2.28	....	....	0.57
August, first week	Milk	87.51	12.49	3.73	2.92	2.29	0.63	5.84	100	87.51	12.49	3.73	2.92	2.29	0.63	5.84
	Whey	93.11	6.89	0.35	0.72	......	....	5.82	89.93	83.73	6.20	0.31	0.65	....	....	5.24
	Green cheese	37.54	62.46	33.96	22.54	......	....	5.96	10.07	3.78	6.29	3.42	2.27	....	....	0.60
August, second week	Milk	87.50	12.50	3.73	2.90	2.29	0.61	5.87	100	87.50	12.50	3.73	2.90	2.29	0.61	5.87
	Whey	93.00	7.00	0.40	0.76	......	....	5.84	90.33	84.01	6.32	0.36	0.69	....	....	5.27
	Green cheese	36.09	63.91	34.85	22.85	......	....	6.21	9.67	3.49	6.18	3.37	2.21	....	....	0.60
August, third week	Milk	87.53	12.47	3.79	2.96	2.35	0.61	5.72	100	87.53	12.47	3.79	2.96	2.35	0.61	5.72
	Whey	93.14	6.86	0.39	0.80	......	....	5.68	89.80	83.64	6.16	0.35	0.72	....	....	5.09
	Green cheese	38.14	61.86	33.72	21.96	......	....	6.18	10.20	3.89	6.31	3.44	2.24	....	....	0.63
August, fourth week	Milk	87.20	12.80	3.99	3.08	2.38	0.70	5.73	100	87.20	12.80	3.99	3.08	2.38	0.70	5.73
	Whey	93.06	6.94	0.40	0.82	......	....	5.72	89.59	83.37	6.22	0.36	0.73	....	....	5.13
	Green cheese	36.79	63.21	34.87	22.57	......	....	5.77	10.41	3.83	6.58	3.63	2.35	....	....	0.60
September, first week	Milk	87.11	12.89	4.03	3.16	2.46	0.70	5.70	100	87.11	12.89	4.03	3.16	2.46	0.70	5.70
	Whey	93.05	6.95	0.46	0.86	......	....	5.63	89.21	83.01	6.20	0.41	0.77	....	....	5.02
	Green cheese	38.00	62.00	33.55	22.15	......	....	6.30	10.79	4.10	6.69	3.62	2.39	....	....	0.68
September, second week	Milk	87.11	12.89	4.00	3.17	2.51	0.66	5.72	100	87.11	12.89	4.00	3.17	2.51	0.66	5.72
	Whey	93.04	6.96	0.42	0.84	......	....	5.70	89.68	83.44	6.24	0.38	0.75	....	....	5.11
	Green cheese	35.56	64.44	35.08	23.45	......	....	5.91	10.32	3.67	6.65	3.62	2.42	....	....	0.61

X. TABULATED AVERAGES OF ANALYSES OF MILK, ETC.—(*Concluded*).

DATE.		COMPOSITION EXPRESSED IN PARTS PER HUNDRED.							FROM ONE HUNDRED POUNDS OF MILK.							
		Per cent. of water.	Per cent. of total solids.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of casein.	Per cent. of albumen.	Per cent. of sugar, ash, etc.	Pounds.	Pounds of water.	Pounds of total solids.	Pounds of fat.	Pounds of casein and albumen.	Pounds of casein.	Pounds of albumen.	Pounds of sugar, ash, etc.
September, third week	Milk	87.10	12.90	4.00	3.23	2.59	0.64	5.67	100	87.10	12.90	4.00	3.23	2.59	0.64	5.67
	Whey	93.02	6.98	0.36	0.88	......	....	5.74	89.36	83.12	6.24	0.32	0.79	....	....	5.13
	Green cheese	37.41	62.59	34.59	22.93	......	....	5.07	10.64	3.98	6.66	3.68	2.44	....	....	0.54
September, fourth week ..	Milk	86.67	13.33	4.20	3.43	2.72	0.71	5.70	100	86.67	13.33	4.20	3.43	2.72	0.71	5.70
	Whey	92.92	7.08	0.46	0.92	......	....	5 70	88.75	82.47	6.28	0.41	0.82	....	....	5.05
	Green cheese	37.33	62.67	33.69	23.20	......	....	5.78	11.25	4.20	7.05	3.79	2.61	....	....	0.65
October, first week	Milk	86.54	13.46	4.20	3.47	2.76	0.71	5.79	100	86.54	13.46	4.20	3.47	2.76	0.71	5.79
	Whey	92.87	7.13	0.40	0.99	......	....	5.74	88.85	82.51	6.34	0.36	0.88	....	....	5 10
	Green cheese	36.14	63.86	34.44	23.23	......	....	6.19	11.30	4.03	7.12	3.84	2.59	....	....	0.70
October, second week.....	Milk	86.43	13.57	4.25	3.50	2.80	0.70	5.82	100	86.43	13.57	4 25	3.50	2.80	0.70	5.82
	Whey	92.75	7.25	0.50	0.99	......	....	5.76	88.70	82.27	6.43	0.44	0.88	....	....	5.11
	Green cheese	36.81	63.19	33.72	23.18	......	....	6.29	11.30	4.16	7.14	3.81	2.62	....	....	0.71
October, third week.......	Milk	86.43	13.57	4.35	3.55	2.83	0.72	5.67	100	86.43	13.57	4.35	3.55	2.83	0.72	5.67
	Whey	92.94	7.06	0.42	0.96	......	....	5.68	88.02	81 81	6.21	0.37	0.85	....	....	4.99
	Green cheese	38.56	61.44	32.22	22.54	......	....	5.68	11.98	4.62	7.36	3.98	2.70	....	....	0.68
October, fourth week	Milk	86.49	13.51	4.25	3.55	2.81	0.74	5.71	100	86.49	13.51	4.25	3.55	2.81	0.74	5.71
	Whey	92.94	7.06	0.39	0.95	......	....	5.73	87.80	81.60	6.20	0.34	0.83	....	....	5.03
	Green cheese	40.08	59.92	32.05	22.30	......	....	5.57	12.20	4.89	7.31	3.91	2.72	....	....	0.68

XI. SUMMARY OF RESULTS RELATING TO CONDITIONS OF MANUFACTURE.

While we can not draw any definite general conclusions from a study of the conditions of manufacture in respect to many important points, it is a matter of interest to consider briefly some of the more prominent facts observed. We shall present, in tabulated form, an outline of the data secured during the season in regard to the following points:

1. Ounces of rennet-extract used for 1,000 pounds of milk.
2. Temperature of milk when rennet was added.
3. Time required for rennet to coagulate the milk completely.
4. Temperature to which curd was heated after being cut.
5. Time from cutting curd to drawing whey.
6. Length of string on hot iron when whey was drawn.
7. Time from drawing whey to putting curd in press.
8. Length of string on hot iron when curd was put in press.
9. Temperature of curd when put in press.
10. Time consumed in operation of cheese-making after adding rennet.

1. OUNCES OF RENNET-EXTRACT USED FOR 1,000 POUNDS OF MILK.

1893.	April.	May.	June.	July.	August.	September.	October.	Average for seoson.
Stone's factory:								
Least	2½	2½	2½	3	2½	2½	.....	.....
Greatest	2½	2½	3	3	2½	2¾	.....	.....
Average	2½	2½	2¾	3	2½	2½	....	2⅔
Merry's factory:								
Least	4	3½	3	3½	3½	3½	.....	.....
Greatest	4	5	3	4½	4	4	.....	.....
Average	4	4	3	4	3¾	4	.....	3¾
48 factories:								
Least	2½	2	2	2	2	3	2	.....
Greatest	5	4	3½	3	5	3	3	.....
Average	3½	3	2½	2½	3	3	2½	2¾

General summary.

OUNCES OF RENNET-EXTRACT USED.	Least.	Greatest.	Average.
	Ounces.	Ounces.	Ounces.
Stone's factory	2½	3	2⅔
Merry's factory	3	5	3¾
Forty-eight factories	2	5	2¾
Average for 1893	......	......	3

The amount of rennet-extract used varied from 2 to 5 ounces per 1,000 pounds of milk and averaged 3 ounces for all the factories during the season of 1893. The variation in the amount of extract used was, in considerable measure, due to the fact that different kinds of extract were used at different factories.

2. TEMPERATURE OF MILK WHEN RENNET WAS ADDED.

1893.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average for season.
	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.
Stone's factory:								
Least	85	86	85	86	86	86	.....	......
Greatest	86	86	86	87	86	86	.....	......
Average	85½	86	86¾	86	86	86	.....	86
Merry's factory:								
Least	86	84	83	84	84	84	.....	......
Greatest	86	87	84	84	86	84	.....	......
Average	86	85	84	84	84	84	.....	84½
48 factories:								
Least	82	80	81	83	82	82	80	......
Greatest	86	86	88	86	85	85	86	......
Average	84	84	84	84	84	84	84	84

General summary.

	Least.	Greatest.	Average.
	Degs. F.	Degs. F.	Degs. F.
Stone's factory	85	87	86
Merry's factory	83	87	84½
Forty-eight factories	80	88	84
Average for 1893	......	......	84½

During the season of 1893 the temperature of the milk, when the rennet was added, varied from 80 degrees to 88 degrees Fahrenheit, and averaged 84½ degrees Fahrenheit.

3. TIME REQUIRED FOR RENNET TO COAGULATE THE MILK COMPLETELY.

1893.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average for season.
	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Min.
Stone's factory:								
Least	12	15	20	20	20	14	.....	......
Greatest	27	25	35	25	25	20	.....	......
Average	20	22	28	24	21	17	.....	22
Merry's factory:								
Least	20	25	30	30	40	30	.....	......
Greatest	25	35	35	40	40	35	.....	......
Average	23	28	31	35	40	33	.....	32
48 factories:								
Least	18	20	14	5	30	35	20	......
Greatest	44	60	78	54	60	42	45	......
Average	31	35	37	35	39	38	30	35

General summary.

	Least.	Greatest.	Average.
	Min.	Min.	Min.
Stone's factory	14	35	22
Merry's factory	20	46	32
Forty-eight factories	5	78	35
Average for 1893	......	......	32

The time required for the rennet to coagulate the milk completely varied from 5 to 78 minutes and averaged 32 minutes for the season of 1893.

4. TEMPERATURE TO WHICH CURD WAS HEATED AFTER BEING CUT.

1893.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average for season.
	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.
Stone's factory:								
Least	96	98	100	102	104	102	.....	.....
Greatest	98	100	102	104	104	105	.....	......
Average	97	99	101	103	104	103	.....	101
Merry's factory:								
Least	99	99	99	100	100	98	.....	......
Greatest	100	99	100	100	100	98	.....	......
Average	99	99	99	100	100	98	.....	99
48 factories:								
Least	95	98	98	96	98	98	96	......
Greatest	99	101	100	103	100	98	100	......
Average	98	98	99	99	98	48	98	98¼

General summary.

	Least	Greatest.	Average.
	Deg. F.	Deg. F.	Deg. F.
Stone's factory	96	105	101
Merry's factory	98	100	99
Forty-eight factories	95	103	98¼
Average for 1893	......	......	99

The temperature to which the curd was heated after being cut varied from 95 degrees to 105 degrees F. and averaged 99 degrees F. The temperature employed at Mr. Stone's was considerably above the average, and undoubtedly caused some extra loss of fat, as will be noticed later.

5. TIME FROM CUTTING CURD TO DRAWING WHEY.

1893.	April.		May.		June.		July.		August.		September.		October.		Average for season.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Stone's factory:																
Least	1	25	2	15	2	15	1	55	1	30	1	40	......		....	
Greatest	3	40	3	10	3	15	2	45	2	15	2	2	......		....	
Average	2	33	2	42	2	52	2	10	1	49	1	51	......		2	20
Merry's factory:																
Least	2	55	3	00	2	55	2	35	2	50	2	40	......		....	
Greatest	4	40	3	35	3	55	3	..	3	45	3	30	......		......	
Average	3	10	3	13	3	22	2	46	3	18	3	4	......		3	15
48 factories:																
Least	2	45	1	40	1	43	2	10	1	55	2	10	2	5	....	
Greatest	5	17	5	30	5	20	3	10	4	10	3	20	3	3	....	
Average	4	00	3	26	3	32	2	42	2	48	2	45	2	34	3	11

General summary.

	Least.		Greatest.		Average.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Stone's factory	1	25	3	30	2	20
Merry's factory	2	35	4	40	3	15
48 factories	1	40	5	30	3	11
Average for 1893	......		......		3	18

The time from cutting curd to drawing whey varied from 1 hour and 25 minutes to 5 hours and 30 minutes, and averaged 3 hours and 18 minutes during the season. The time decreased somewhat from month to month as the season advanced.

6. LENGTH OF STRING ON HOT IRON WHEN WHEY WAS DRAWN.

1893.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average for season.
	Inches	Inches	Inches	Inches	Inches.	Inches.	Inches.	Inches.
Stone's factory:								
Least	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$	....	......
Greatest	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$	....	......
Average	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$	....	$\frac{3}{8}$
Merry's factory:								
Least	trace	trace	$\frac{1}{4}$	trace	$\frac{1}{4}$	$\frac{1}{4}$	....	......
Greatest	trace	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	....	......
Average	trace	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	....	$\frac{1}{4}$
48 factories:								
Least	$\frac{1}{8}$	trace	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{8}$	......
Greatest	$\frac{1}{4}$	$1\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	......
Average	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

General summary.

	Least.	Greatest.	Average.
Stone's factory	$\frac{1}{4}$ inch.	$\frac{1}{2}$ inch.	$\frac{3}{8}$ inch.
Merry's factory	trace.	$\frac{1}{4}$ inch.	$\frac{1}{4}$ inch.
48 factories	trace.	$1\frac{1}{4}$ inch.	$\frac{1}{4}$ inch.
Average for 1893	......	....	$\frac{1}{4}$ inch.

The length of string found on a hot iron when the whey was drawn varied from a trace to 1¼ inches, and averaged ¼ inch during the season.

7. TIME FROM DRAWING WHEY TO PUTTING CURD IN PRESS.

1893.	April.	May.	June.	July.	Aug	Sept.	Oct.	Average for season.	
	Min.	Min.	Min.	Min.	Min.	Min.	Min.	Hrs.	Min.
Stone's factory:									
Least	40	65	70	85	55	140	.....	....	
Greatest	50	85	115	140	105	190	.....	....	
Average	45	72	84	107	86	165	.....	1	15
Merry's factory:									
Least	55	115	70	100	130	135	.....	....	
Greatest	100	160	135	165	175	190	.....	....	
Average	77	133	104	132	152	158	.....	1	55
48 factories:									
Least	55	40	45	115	150	165	45	....	
Greatest	135	220	195	375	275	175	195	....	
Average	86	114	129	197	207	170	132	2	5

General summary.

	Least.		Greatest.		Average.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Stone's factory		40	3	10	1	15
Merry's factory		55	3	10	1	55
Forty-eight factories		40	6	15	2	5
Average for 1893	......		......		1	53

The time from drawing whey to putting curd in press varied from 40 minutes to 6 hours and 15 minutes and averaged 1 hour and 53 minutes during the season of 1893.

8. LENGTH OF STRING ON HOT IRON WHEN CURD WAS PUT IN PRESS.

1893.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average for season.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Stone's factory:								
Least	1	1¼	2¼	4	4	4	.....	......
Greatest	1½	2	3½	4	4	4	.....	......
Average	1¼	1½	2¾	4	4	4	.....	3
Merry's factory:								
Least	½	½	1	1	1¼	1½	.....	......
Greatest	½	1	1¼	1	1¼	1½	.....	......
Average	½	¾	1⅛	1	1¼	1½	.....	1
48 factories:								
Least	½	½	½	¾	¼	½	½	......
Greatest	½	2	2	2½	2	2½	1	......
Average	½	1⅛	1¼	1¼	1¼	1¼	¾	1⅛

General summary.

	Least.	Greatest.	Average.
	Inches.	Inches.	Inches.
Stone's factory	1	4	3
Merry's factory	½	1½	1
Forty-eight factories	½	2½	1⅛
Average for 1893	......	......	1½

The length of string formed on a hot iron when the curd was put in press varied from half an inch to four inches, and averaged one and one half inches during the season.

9. TEMPERATURE OF CURD WHEN PUT IN PRESS.

1893.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average for season.
	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.	Deg. F.
Stone's factory:								
Least	85	80	76	70	74	78	.....	......
Greatest	90	82	80	77	84	78	.....	......
Average	87	81	79	74	79	78	.....	79
Merry's factory:								
Least	85	83	85	86	85	85	.....	......
Greatest	85	85	86	86	85	85	.....	......
Average	85	84	85½	86	85	85	.....	85
48 factories:								
Least	78	78	74	70	70	80	72	......
Greatest	85	86	85	85	85	85	85	......
Average	82	82	81	79	78	82½	78	80½

General summary.

	Least.	Greatest.	Average.
	Deg. F.	Deg. F.	Deg. F.
Stone's factory	70	90	79
Merry's factory	83	86	85
48 factories	70	86	80½
Average for 1893	......	......	81

The temperature of the curd when put in press varied from 70 degrees Fahr. to 90 degrees Fahr., and averaged 81 degrees Fahr. during the season of 1893.

10. TIME CONSUMED IN OPERATION OF CHEESE-MAKING AFTER ADDING RENNET.

1893.	April.		May.		June.		July.		August.		September.		October.		Average for season.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Stone's factory:																
Least	2	12	4	5	4	50	3	55	3	00	4	45	......		....	
Greatest	4	42	4	55	5	25	5	15	4	25	5	26	......		....	
Average	3	27	4	34	5	5	4	35	3	48	5	5	......		4	28
Merry's factory:																
Least	4	20	5	20	4	30	5	00	5	45	5	25	......		....	
Greatest	5	45	6	35	6	35	6	15	6	40	6	20	......		......	
Average	5	5	5	53	5	32	5	56	6	19	5	57	......		5	47
Forty-eight factories:																
Least	5	30	4	00	5	30	6	00	7	00	5	00	5	30	......	
Greatest	6	50	8	20	9	30	9	50	8	10	6	40	6	45	....	
Average	6	20	6	18	7	12	7	17	7	36	5	50	6	7	6	40

General summary.

	Least.		Greatest.		Average.	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Stone's factory	2	12	5	26	4	28
Merry's factory	4	20	6	40	5	47
Forty-eight factories	4	00	9	50	6	40
Average for 1893	......		......		6	00

The amount of time consumed in the operation of cheese-making after the rennet was added varied from 2 hours and 12 minutes to 9 hours and 50 minutes and averaged 6 hours for the season.

XII. A STUDY OF THE COMPOSITION OF MILK DURING THE SEASON.

The data which have been accumulated during the past two years in connection with this investigation afford abundant material for studying the composition of milk, whey and cheese and also the variations in composition which occur with the advance of the season. While chemical and dairy literature contains many analyses of the milk of individual cows, we have nowhere, outside of our own station records, been able to find complete analyses based upon the mixed milk of large numbers of cows and covering an extended, continuous period of time. Our data furnish us the most satisfactory means we have yet met with for determining the average composition of the milk of our dairy cows in New York State; and the same is true of the whey and cheese.

The object of studying the composition of factory milk in connection with our investigation of cheese-making has been two-fold. It is important, in the first place, to know what the composition of factory milk is, taken as a whole, and to what variations it is naturally subject during the factory season, since the yield of cheese depends primarily upon the composition of the milk. In the second place, it is desirable to know more thoroughly than has been possible, heretofore, the average and variable composition of milk, in order to ascertain whether the laws prescribing a fixed standard of purity for milk are based upon actual facts, since the decision of this point involves the question of justice or injustice in the action of the statutes now in operation.

The milk studied represents the mixed morning and evening normal milk of numerous herds of cows. Since most dairymen who take their milk to cheese factories have their cows come in milk in the spring, our data represent the changes due to the advance of the period of lactation, modified, to a greater or less extent, by special conditions, such as food, weather, etc.

We shall take up this study of the composition of milk under the following heads:

1. Pounds of solids in 100 pounds of milk.
2. Pounds of solids not fat in 100 pounds of milk.
3. Pounds of cheese-producing solids (fat and casein) in 100 pounds of milk.
4. Pounds of whey-solids (albumen, sugar, etc.) in 100 pounds of milk.
5. Pounds of fat in 100 pounds of milk.
6. Pounds of casein and albumen in 100 pounds of milk.
7. Pounds of casein in 100 pounds of milk.
8. Pounds of albumen in 100 pounds of milk.
9. Relation of casein to albumen in normal milk.
10. Relation of fat to casein in normal milk.
11. Relation of fat to casein and albumen in normal milk.
12. General summary of results.

Table Showing Weekly and Monthly Averages of Composition of Milk During the Season.

1893.	Per cent. of water.	Per cent. of solids.	Per cent. of solids not fat.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of casein.	Per cent. of albumen.	Per cent. of sugar, ash, etc.
April.								
Second week	88.00	12.00	8.57	3.43	2.87	2.34	0.53	5.70
Third week	87.94	12.06	8.59	3.47	2.80	2.30	0.50	5.79
Fourth week	88.11	11.89	8.49	3.40	2.78	2.24	0.54	5.71
Average for April	88.02	11.98	8.55	3.43	2.81	2.29	0.52	5.74
May.								
First week	87.91	12.09	8.63	3.46	2.81	2.23	0.58	5.82
Second week	87.84	12.16	8.70	3.46	2.90	2.27	0.63	5.80
Third week	87.61	12.39	8.79	3.60	3.03	2.34	0.69	5.76
Fourth week	87.11	12.89	9.08	3.81	3.31	2.56	0.75	5.77
Average for May	87.44	12.56	8.89	3.67	3.11	2.43	0.68	5.78
June.								
First week	87.26	12.74	9.07	3.67	3.26	2.48	0.78	5.81
Second week	87.44	12.56	9.03	3.53	3.24	2.49	0.75	5.79
Third week	87.22	12.78	9.05	3.73	3.24	2.48	0.76	5.81
Fourth week	87.38	12.62	8.99	3.63	3.20	2.47	0.73	5.79
Average for June	87.31	12.69	9.03	3.66	3.23	2.48	0.75	5.80

Table Showing Weekly and Monthly Averages of Composition of Milk During the Season—(*Continued*).

1893.	Per cent of water.	Per cent of solids.	Per cent. of solids not fat.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of casein.	Per cent. of albumen.	Per cent. of sugar, ash, etc.
July.								
First week	87.53	12.47	8.97	3.50	3.10	2.41	0.69	5.87
Second week	87.52	12.48	8.88	3.60	3.08	2.40	0.68	5.80
Third week	87.49	12.51	8.87	3.64	3.09	2.39	0.70	5.78
Fourth week	87.58	12.42	8.77	3.65	2.99	2.33	0.66	5.78
Average for July	87.52	12.48	8.86	3.62	3.06	2.38	0.68	5.80
August.								
First week	87.51	12.49	8.76	3.73	2.92	2.29	0.63	5.84
Second week	87.50	12.50	8.77	3.73	2.90	2.29	0.61	5.87
Third week	87.53	12.47	8.68	3.79	2.96	2.35	0.61	5.72
Fourth week	87.20	12.80	8.81	3.99	3.08	2.38	0.70	5.73
Average for August	87.37	12.63	8.76	3.87	3.01	2.35	0.66	5.75
September.								
First week	87.11	12.89	8.86	4.03	3.16	2.46	0.70	5.70
Second week	87.11	12.89	8.89	4.00	3.17	2.51	0.66	5.72
Third week	87.10	12.90	8.90	4.00	3.23	2.59	0.64	5.67
Fourth week	86.67	13.33	9.13	4.20	3.43	2.72	0.71	5.70
Average for September	87.00	13.00	8.94	4.06	3.24	2.56	0.68	5.70

October.								
First week	86.54	13.46	9.26	4.20	3.47	2.76	0.71	5.79
Second week	86.63	13.37	9.15	4.22	3.43	2.74	0.69	5.72
Third week	86.43	13.57	9.17	4.40	3.52	2.81	0.71	5.65
Fourth week	86.59	13.41	9.17	4.24	3.47	2.75	0.72	5.70
Average for October	86.55	13.45	9.17	4.28	3.48	2.77	0.71	5.69

1. POUNDS OF SOLIDS IN ONE HUNDRED POUNDS OF MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	11.47	12.41	12.47	12.35	12.20	13.19	....
Greatest	......	12.48	12.65	12.73	12.96	12.76	13.91	....
Average	......	11.92	12.53	12.60	12.69	12.55	13.58	12.64
1893.								
Stone's factory:								
Least	11.98	12.28	12.61	12.43	12.42	12.95	13.09	....
Greatest	12.23	12.94	12.92	12.65	12.58	13.01	13.25	....
Average	12.10	12.60	12.73	12.54	12.51	12.98	13.17	12.66
Merry's factory:								
Least	11.93	11.91	12.36	12.31	12.44	12.73	13.27	....
Greatest	11.98	12.90	12.67	12.42	12.84	13.26	13.87	....
Average	11.96	12.43	12.50	12.37	12.59	12.90	13.52	12.62
48 factories:								
Least	11.70	11.88	12.42	12.28	12.43	12.99	13.42	....
Greatest	12.07	13.13	12.91	12.82	13.07	13.40	13.72	....
Average	11.91	12.58	12.74	12.50	12.74	13.20	13.53	12.72
Average for 1893	11.98	12.56	12.69	12.48	12.63	13.00	13.45	12.68
Average for 1892 and 1893	11.98	12.43	12.64	12.52	12.65	12.86	13.50	12.67

Tabulated general summary.

	Pounds of Total Solids in 100 Pounds of Milk.		
	Least.	Greatest.	Average.
Season of 1892	11.47	13.91	12.64
Season of 1893:			
Stone's factory	11.98	13.25	12.66
Merry's factory	11.91	13.87	12.62
Forty-eight factories	11.70	13.72	12.72
Average for 1892 and 1893	......	......	12.67

a. If, in the first of the foregoing tables, we compare the variations in the amount of milk-solids, we notice that, month for month, the variations are quite uniform. In the general averages for the season, the results are remarkably close, when we consider the variety of conditions under which the milk was produced.

b. In studying the monthly averages for 1893, we notice that there was a constant increase in solids through April, May and June, then a marked decrease in July, which continued through the first half of August, after which the solids increased and continued so to do during the rest of the season.

The question at once suggests itself as to why the months of July and August formed an exception to the general rule that the milk-solids increase as the period of lactation advances. As we shall see later, the change was such as to have a far-reaching influence upon the composition of the milk and upon its relation to cheese-making. Only one explanation can be found for the facts: In July the pastures commenced drying up and this continued well into August; this condition was made worse by the activity and number of grasshoppers that came in August; add to this the effect of the warm weather and annoyance by flies and we have what is undoubtedly the true explanation of the facts observed. It has been very generally believed that decrease of yield of milk is always accompanied by increase of milk-solids. We appear to have an exceptional case here, and it will be of especial interest to notice upon what constituents of the milk-solids the decrease largely fell. There was, of course a really abnormal condition in the matter of food, to say nothing of other unfavorable conditions. The food was excessively dry and it is probable that there was, to some extent, a mild form of starvation. The facts observed suggest a very interesting field for special research.

c. In connection with the foregoing general question as regards the influence of food upon the composition of milk, another observed fact is of much interest. In studying the detailed results, as given in previous bulletins, it will be noticed that about the middle of May there was a very marked change in the character of the milk. Taking the results for the first half and second half of May, the following arrangement makes prominent the fact above stated:

	POUNDS OF SOLIDS IN 100 POUNDS OF MILK.	
	First half of May.	Second half of May.
Stone's factory	12.28	12.75
Merry's factory	11.96	12.75
Other factories	12.18	12.82
	12.14	12.79

This increase can hardly have been accidental, because it was noticed to take place in all the factories. The explanation lies in the fact that the cows were turned into pasture about the middle of May. The influence was not only an increase in yield of milk but also an increase of the milk-solids. Our season's work, therefore, brings out incidentally the influence of food upon the composition and yield of milk, (1st) when there was a change from dry to succulent food, and (2d) when there was a change from succulent back to dry food. How much influence actual lack of food had early in May and again when the pastures became dry, it is impossible to say. It would appear, then, that an abrupt change from dry to succulent food may produce the double effect of increasing not only the yield of milk but also an actual increase of milk-solids in 100 pounds of milk; and a marked change from succulent to dry food may produce, on the other hand, not only a decreased yield of milk but also an actual decrease of milk-solids in 100 pounds of milk.

2. POUNDS OF SOLIDS NOT FAT IN 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average for season.
Least	.....	8.27	8.89	8.85	8.82	8.60	9.14	......
Greatest	.....	9.11	9.03	9.23	8.98	8.88	9.66	......
Average	.....	8.72	8.95	8.97	8.92	8.74	9.44	8.94
1893. Stone's factory:								
Least	8.58	8.68	9.01	8.73	8.62	8.95	8.89	......
Greatest	8.68	9.14	9.12	9.05	8.75	9.01	8.98	......
Average	8.63	8.90	9.05	8.89	8.70	8.98	8.94	8.88
Merry's factory:								
Least	8.48	8.61	8.86	8.71	8.72	8.73	9.07	......
Greatest	8.53	9.09	8.99	8.89	8.80	9.06	9.30	......
Average	8.51	8.88	8.92	8.82	8.77	8.85	9.20	8.86
48 factories:								
Least	8.40	8.58	8.82	8.77	8.68	8.89	9.12	.....
Greatest	8.63	9.17	9.16	9.02	8.97	9.20	9.35	......
Average	8.52	8.89	9.06	8.87	8.80	9.05	9.26	8.95
Average for 1893	8.55	8.89	9.03	8.86	8.76	8.94	9.17	8.91
Average for 1892 and 1893	8.55	8.85	9.00	8.90	8.81	8.88	9.27	8.92

TABULATED GENERAL SUMMARY.

Pounds of solids not fat in 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	8.27	9.66	8.94
Season of 1893:			
Stone's factory	8.58	9.14	8.88
Merry's factory	8.48	9.30	8.86
Forty-eight factories	8.40	9.35	8.95
Average for 1892 and 1893	......	......	8.92

a. A comparison, month by month, of the amount of solids not fat in the table above shows that in each month the amount was strikingly close in the milk of the different factories; and, likewise, the averages for the entire season differed from one another within very narrow limits.

b. In studying the monthly averages for 1893, we notice that, at the different factories, there was an increase of solids not fat during May and June but a decrease during July and August and then an increase during the rest of the season. This accords with the facts already pointed out in connection with the variation of total solids that occurred during the season, and the same explanation given above applies here also.

3. POUNDS OF CHEESE-PRODUCING SOLIDS (FAT AND CASEIN) IN 100 POUNDS OF MILK.

	April.	May.	June.	July.	August.	September.	October.	Average for season.
1892.								
Least	.....	4.97	5.81	5.97	5.95	6.02	6.27	.....
Greatest	.....	5.43	6.27	6.29	6.49	6.56	7.35	.....
Average	...	5.20	6.02	6.14	6.23	6.34	7.02	6.16
1893.								
Stone's factory:								
Least	5.68	5.93	6.11	6.01	6.10	6.46	6.79	.....
Greatest	5.89	6.31	6.23	6.11	6.26	6.53	7.04	.....
Average	5.78	6.13	6.16	6.05	6.16	6.50	6.90	6.24
Merry's factory:								
Least	5.68	5.48	5.83	5.77	5.84	6.48	6.90	.....
Greatest	5.79	6.24	6.09	5.89	6.52	6.94	7.44	.....
Average	5.74	6.91	5.97	5.85	6.12	6.63	7.09	6.19
48 factories:								
Least	5.50	5.51	5.86	5.76	6.06	6.53	6.96	.....
Greatest	5.79	6.66	6.36	6.35	6.49	6.89	7.22	....
Average	5.66	6.13	6.18	6.04	6.33	6.71	7.08	6.25
Average for 1893	5.72	6.10	6.14	6.00	6.22	6.62	7.05	6.23
Average for 1892 and 1893	5.72	5.92	6.11	6.05	6.23	6.53	7.04	6.21

TABULATED GENERAL SUMMARY.

Pounds of cheese-producing solids in 100 pounds of milk.

	Least.	Greatest.	Average.
Season of 1892	4.97	7.35	6.16
Season of 1893:			
Stone's factory	5.68	7.04	6.24
Merry's factory	5.48	7.44	6.19
Forty-eight factories	5.50	7.22	6.25
Average for 1892 and 1893	....	....	6.21

a. The amounts of cheese-producing solids (fat and casein) show close agreement, when we study the results of the two seasons and the results of the different factories where work was done during 1893. The general averages differ within narrow limits.

b. The cheese-solids increased during May and June, decreased in July and then increased during the rest of the season. The fluctuations were not so great with the cheese-solids as with the total solids of the milk.

4. POUNDS OF WHEY-SOLIDS (ALBUMEN, SUGAR, ETC.) IN 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	6.36	6.44	6.35	6.36	6.11	6.40	....
Greatest	......	7.03	6.66	6.72	6.51	6.31	6.69	....
Average	......	6.72	6.51	6.46	6.46	6.21	6.56	6.48
1893.								
Stone' factory:								
Least	6.30	6.35	6.49	6.40	6.32	6.48	6.21	....
Greatest	6.34	6.63	6.69	6.55	6.39	6.49	6.31	....
Average	6.31	6.47	6.57	6.49	6.35	6.48	6.27	6.42
Merry's factory:								
Least	6.19	6.30	6.49	6.45	6.31	6.25	6.37	....
Greatest	6.26	6.66	6.58	6.57	6.60	6.32	6.51	....
Average	6.22	6.52	6.54	6.52	6.47	6.27	6.43	6.43
Forty-eight factories:								
Least	6.20	6.36	6.42	6.40	6.32	6.46	6.28	....
Greatest	6.29	6.57	6.66	6.59	6.58	6.51	6.52	....
Average	6.25	6.45	6.56	6.46	6.41	6.49	6.45	6.47
Average for 1893	6.26	6.46	6.55	6.48	6.41	6.38	6.40	6.45
Average for 1892 and 1893	6.26	6.51	6.53	6.47	6.40	6.33	6.47	6.46

TABULATED GENERAL SUMMARY.

Pounds of whey-solids in 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	6.11	7.03	6.48
Season of 1893:			
Stone's factory	6.21	6.69	6.42
Merry's factory	6.19	6.66	6.43
Forty-eight factories	6.20	6.66	6.47
Average for 1892 and 1893	......	......	6.46

a. The same agreement in the monthly and general season averages is, as previously noticed in the other solids, noticeable in connection with the whey-solids (sugar, albumen, etc.).

b. The amount of whey-solids (sugar, albumen, etc.), increased during May and June, decreased during July and August, and then, in general, increased slightly during September and October.

5. POUNDS OF FAT IN 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	3.04	3.45	3.50	3.50	3.55	4.05	....
Greatest	......	3.37	3.70	3.75	4.00	3.95	3.35	....
Average	......	3.20	3.58	3.63	3.77	3.81	4.14	3.69
1893.								
Stone's factory:								
Least	3.40	3.60	3.60	3.55	3.75	4.00	4.20	....
Greatest	3.55	3.80	3.80	3.70	3.90	4.00	4.30	....
Average	3.47	3.70	3.68	3.65	3.81	4.00	4.23	3.78
Merry's factory:								
Least	3.45	3.30	3.50	3.45	3.65	4.00	4.20	....
Greatest	3.45	3.80	3.70	3.60	4.10	4.20	4.10	....
Average	3.45	3.55	3.58	3.55	3.82	4.05	4.32	3.76
Forty-eight factories:								
Least	3.30	3.30	3.40	3.50	3.75	4.10	4.20	....
Greatest	3.50	4.00	3.80	3.80	4.10	4.20	4.40	....
Average	3.39	3.69	3.68	3.63	3.94	4.15	4.27	3.77
Average for 1893	3.43	3.67	3.66	3.62	3.87	4.06	4.28	3.77
Average for 1892 and 1893	3.43	3.58	3.64	3.62	3.84	3.92	4.23	3.75

TABULATED GENERAL SUMMARY.

Pounds of fat in 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	3.04	4.35	3.69
Season of 1893:			
Stone's factory	3.40	4.30	3.78
Merry's factory	3.30	4.60	3.76
Forty-eight factories	3.30	4.40	3.77
Average for 1892 and 1893	....	....	3.75

a. The season's average amount of fat found in the milk of different factories is so close as to be practically the same. The monthly averages show quite close agreements. It is safe to say that the above average, 3.75 per cent very closely represents the season's average of the milk taken to cheese-factories in this State.

b. The fat increased in May and remained about the same during May and June; there was a slight decrease in July and then a steady increase during the rest of the season. The fat was much less affected than the solids not fat by the dry pastures. It will be seen that in August as compared with July there was an increase of fat but a decrease of solids not fat.

6. POUNDS OF CASEIN AND ALBUMEN IN 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	2.53	3.20	3.03	3.00	3.07	3.56	....
Greatest	......	2 78	3.30	3.10	3.09	3.22	3.76	....
Average	......	2.65	3.25	3.08	3.04	3.12	3.66	3.13
1893.								
Stone's factory:								
Least	2.81	3.06	3.23	2.97	2.89	3.13	3.29	....
Greatest	2.82	3.34	3.30	3.18	3.01	3.21	3.45	....
Average	2.82	3.22	3.27	3.08	2.93	3.17	3.36	3.12
Merry's factory:								
Least	2.77	2.76	3.07	2.96	2.89	3.12	2.42	....
Greatest	2.89	3.24	3.21	3.02	3.07	3.43	3.52	....
Average	2.81	3.03	3.14	2.99	2.99	3.23	3.47	3.11
Forty-eight factories:								
Least	2.75	2.79	3.08	2.96	2.95	3.20	3.47	....
Greatest	2.86	3.40	3.34	3.23	3.15	3.42	3.60	....
Average	2.80	3.11	3.25	3.09	3.07	3.31	3.53	3.17
Average for 1892	2.81	3.11	3.23	3.06	3.01	3.24	3.48	3.14
Average for 1892 and 1893	2.81	3.02	3.24	3.07	3.02	3.20	3.55	3.14

TABULATED GENERAL SUMMARY.

Pounds of casein and albumen in 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	2.53	3.76	3.13
Season of 1893:			
Stone's factory	2.81	3.45	3.12
Merry's factory	2.76	3.52	3.11
Forty-eight factories	2.75	3.60	3.17
Average for 1892 and 1893	......	......	3.14

a. The uniformity in the averages of months and seasons is noticeable here, as in the case of the other compounds previously studied.

b. The casein and albumen increased during May and June and then decreased in July and more in August, after which they increased for the rest of the season. Thus, by comparison with the fat, it will be seen that the casein and albumen were much more seriously affected by the drought.

7. POUNDS OF CASEIN IN 100 POUNDS OF MILK.

	April.	May.	June.	July.	August.	September.	October.	Average for season.
1892.								
Least	.....	1.93	2.36	2.47	2.45	3.47	2.71	.....
Greatest	.....	2.06	2.57	2.54	2.49	2.61	3.00	.....
Average	.....	2.00	2.44	2.51	2.46	2.53	2.88	2.47
1893.								
Stone's factory:								
Least	2.28	2.33	2.43	2.33	2.30	2.46	2.59	.....
Greatest	2.34	2.51	2.56	2.50	2.38	2.53	2.74	.....
Average	2.31	2.43	2.49	2.40	2.35	2.50	2.67	2.45
Merry's factory:								
Least	2.23	2.18	2.33	2.26	2.19	2.48	2.70	.....
Greatest	2.34	2.46	2.45	2.34	2.42	2.74	2.84	.....
Average	2.29	2.36	2.39	2.30	2.30	2.58	2.77	2.43
48 factories:								
Least	2.20	2.18	2.40	2.26	2.30	2.43	2.76	.....
Greatest	2.34	2.66	2.60	2.55	2.49	2.69	2.85	.....
Average	2.27	2.44	2.50	2.41	2.39	2.56	2.81	2.48
Average for 1893	2.29	2.43	2.48	2.38	2.35	2.56	2.77	2.46
Average for 1892 and 1893	2.29	2.34	2.47	2.43	2.39	2.55	2.81	2.46

TABULATED GENERAL SUMMARY.

Pounds of casein in 100 pounds of milk.

	Least.	Greatest.	Average.
Season of 1892	1.93	3.00	2.47
Season of 1893:			
Stone's factory	2.28	2.74	2.45
Merry's factory	2.23	2.84	2.43
Forty-eight factories	2.18	2.85	2.48
Average for 1892 and 1893	....	....	2.46

a. The averages of the different factories and of the two different seasons are surprisingly close, all being within a limit of 0.05 per cent of casein.

b. The casein increased during May and June and then decreased during July and August, after which it increased for the rest of the season. Increase of fat in milk is generally accompanied by an increase of casein; but, under the abnormal conditions prevailing in July and August, the casein actually decreased while the fat increased.

8. POUNDS OF ALBUMEN IN 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	0.60	0.73	0.56	0.55	0.57	0.71	....
Greatest	......	0.77	0.87	0.60	0.63	0.64	0.86	....
Average	......	0.65	0.81	0.57	0.58	0.59	0.78	0.66
1893.								
Stone's factory:								
Least	0.47	0.73	0.72	0.64	0.52	0.67	0.67	....
Greatest	0.54	0.83	0.87	0.71	0.65	0.68	0.71	....
Average	0.51	0.79	0.78	0.68	0.58	0.67	0.69	0.67
Merry's factory:								
Least	0.48	0.55	0.70	0.68	0.65	0.63	0.68	....
Greatest	0.55	0.80	0.78	0.71	0.80	0.69	0.72	....
Average	0.52	0.67	0.75	0.69	0.69	0.65	0.70	0.68
Forty-eight factories:								
Least	0.52	0.58	0.68	0.60	0.61	0.73	0.65	....
Greatest	0.55	0.77	0.81	0.75	0.78	0.77	0.78	....
Average	0.53	0.67	0.75	0.68	0.68	0.75	0.72	0.69
Average for 1893	0.52	0.68	0.75	0.68	0.66	0.68	0.71	0.68
Average for 1892 and 1893	0.52	0.68	0.77	0.64	0.61	0.65	0.74	0.68

TABULATED GENERAL SUMMARY.

Pounds of albumen in 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	0.55	0.86	0.66
Season of 1893:			
Stone's factory	0.47	0.87	0.67
Merry's factory	0.48	0.80	0.68
Forty-eight factories	0.52	0.81	0.69
Average for 1892 and 1893	......	......	0.68

a. The averages of the different factories for the two seasons differ by only 0.03 per cent of albumen, all showing close agreement.

b. The albumen increased during May and June, 1893, and decreased during July and August, and then increased a little during September and October. There was greater proportionate decrease of albumen in July and August than of any other single constituent of the milk.

9. RELATION OF CASEIN TO ALBUMEN IN NORMAL MILK.

Table showing relation of casein and albumen in milk.

1893.	Per cent of casein and albumen in milk.	Per cent of casein in milk.	Per cent of albumen in milk.	Pounds of casein for 100 lbs. of casein and albumen.	Pounds of albumen for 100 lbs. of casein and albumen.	Pounds of casein for one pound of albumen.
April.						
Second week.......	2.87	2.34	0.53	81.53	18.47	4.42
Third week.........	2.80	2.30	0.50	82.14	17.86	4.60
Fourth week.......	2.78	2.24	0.54	80.58	19.42	4.15
Average for April.	2.81	2.29	0.52	81.50	18.50	4.21
May.						
First week.........	2.81	2.23	0.58	79.35	21.65	3.85
Second week.......	2.90	2.27	0.63	78.28	21.72	3.60
Third week.........	3.03	2.34	0.69	77.23	22.77	3.39
Fourth week.......	3.31	2.56	0.75	77.34	22.66	3.41
Average for May..	3.11	2.43	0.68	78.14	21.86	3.57
June						
First week........	3.26	2.48	0.78	76.07	23.93	3.18
Second week.......	3.24	2.49	0.75	76.85	23.15	3.22
Third week........	3.24	2.48	0.76	76.54	23.46	3.26
Fourth week.......	3.20	2.47	0.73	77.19	22.81	3.38
Average for June.	3.23	2.48	0.75	76.78	23.22	3.30
July.						
First week........	3.10	2.41	0.69	77.74	22.26	3.49
Second week.......	3.08	2.40	0 68	77.92	22.08	3.53
Third week........	3.09	2.39	0.70	77.33	22.66	3.41
Fourth week.......	2.99	2.33	0.66	77.93	22.07	3.53
Average for July.	3.06	2.38	0.68	77.78	22.22	3.50
August.						
First week.........	2.92	2.29	0.63	78.42	21.52	3.63
Second week.......	2.90	2.29	0.61	78.97	21.03	3.75
Third week........	2.96	2.35	0.61	79.39	20.61	3.85
Fourth week.......	3.08	2.38	0.70	77.27	22.73	3.40
Average for Aug..	3.01	2.35	0.66	78.07	21.93	3.56

Table showing relation of casein to albumen in milk — (Concluded).

1893.	Per cent of casein and albumen in milk	Per cent of casein in milk	Per cent of albumen in milk.	Pounds of casein for 100 lbs. of casein and albumen.	Pounds of albumen for 100 lbs. of casein and albumen.	Pounds of casein for one pound of albumen.
September.						
First week.........	3.16	2.46	0.70	77.85	22.15	3.51
Second week.......	3.17	2.51	0.66	79.18	20.82	3.80
Third week........	3.23	2.59	0.64	80.19	19.81	4.05
Fourth week.......	3.43	2.72	0.71	79.30	20.70	3.83
Average for Sept.	3.24	2.56	0.68	79.00	21.00	3.76
October.						
First week.........	3.47	2.76	0.71	79.54	20.46	3.89
Second week.......	3.43	2.74	0.69	79.90	20.10	3.97
Third week	4.52	2.81	0.71	79.83	20.17	3.96
Fourth week.......	3.47	2.75	0.72	79.25	20.75	3.82
Average for Oct..	3.48	2.77	0.71	79.60	20.40	3.90

TABLE SHOWING POUNDS OF CASEIN FOR ONE POUND OF ALBUMEN IN NORMAE MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	2.60	2.70	4.10	3.90	3.90	3.20	....
Greatest	......	3.40	3.50	4.50	4.50	4.60	4.20	....
Average	......	3.10	3.00	4.40	4.20	4.30	3.70	3.74
1893.								
Stone's factory:								
Least	4.22	3.02	2.80	3.37	3.63	3.67	3.70	....
Greatest	4.98	3.19	3.51	3.68	5.58	3.72	4.00	....
Average	4.57	3.08	3.20	3.53	4.05	3.70	3.87	3.66
Merry's factory:								
Least	4.13	3.05	3.06	3.18	2.92	3.76	3.75	....
Greatest	4.79	4.09	3.39	3.44	4.23	4.05	4.18	....
Average	4.40	3.52	3.19	3.33	3.33	3.97	3.96	3.57
Forty-eight factories:								
Least	4.00	3.30	3.00	3.01	2.95	3.16	3.61	....
Greatest	4.50	4.02	3.66	4.18	4.08	3.68	4.37	....
Average	4.28	3.64	3.33	3.54	3.51	3.41	3.90	3.60
Average for 1893	4.40	3.57	3.30	3.50	3.56	3.76	3.90	3.62
Average for 1892 and 1893	4.40	3.44	3.21	3.80	3.92	3.92	3.80	3.66

Tabulated General Summary.

Pounds of casein for one pound of albumen in milk.

	Least.	Greatest.	Average.
Season of 1892	2.60	4.60	3.74
Season of 1893:			
Stone's factory	2.80	5.58	3.66
Merry's factory	2.92	4.79	3.57
Forty-eight factories	2.95	4.50	3.60
Average for 1892 and 1893	......	......	3.66

a. The proportion of casein to albumen varied within wide limits in each set of experiments, but the general averages are quite close.

b. Taking the general monthly averages, we find that the proportion of casein, relative to albumen, was greatest in April and diminished during May and June, after which it increased continuously during the rest of the season.

The effect of the food and weather upon the casein and albumen was such as to decrease both in July and August, as we have previously seen; but the decrease affected the albumen more than the casein and, consequently, there was an increased amount of casein relative to albumen in July and August. This fact is of importance in connection with cheese-making, since the decrease in cheese-yield was not so great as it would have been, had the decrease fallen upon the casein exclusively or more than upon the albumen. The facts fully confirm those secured last year and show that the proportion of casein to albumen in milk is very variable. The fact is also demonstrated more emphatically than ever that, in studying the composition of milk with reference to cheese-making, we can not be guided by the amount of casein and albumen taken together but must know the amount of casein by itself, separate from the albumen.

10. Relation of Fat to Casein in Normal Milk.

Fat and casein are the two constituents of milk that are most essential to the production of cheese, and the amount of these two substances in milk largely determines the yield of cheese. If these two substances are present in milk in proportions that are at all uniform, relative to each other, then either one of them can be used as a factor to ascertain how much cheese should be made from milk. Our work in 1892 tended to show that the relation of fat to casein in normal-factory milk was a fairly uniform one, and the average for the whole season's work showed that usually there would be found in normal factory-milk 1.5 pounds of fat for one pound of casein. If this relation is fairly uniform and if the casein increases relatively in amount when the fat increases, then the fat must be a fairly accurate guide in determining the amount of cheese that can be made from milk.

TABLE SHOWING RELATION OF CASEIN TO FAT IN NORMAL MILK.

1893.	Per cent. of fat in milk.	Per cent. of casein in milk.	Pounds of fat for one pound of casein in milk.	Pounds of casein for one pound of fat in milk.
April.				
First week	3.43	2.34	1.47	0.68
Second week	3.47	2.30	1.51	0.66
Third week	3.40	2.24	1.52	0.66
Average for April	3.43	2.29	1.50	0.66
May.				
First week	3.46	2.23	1.55	0.64
Second week	3.46	2.27	1.52	0.66
Third week	3.60	2.34	1.53	0·65
Fourth week	3.81	2.56	1.49	0.66
Average for May	3.67	2.43	1.51	0.66
June.				
First week	3.67	2.48	1.48	0.68
Second week	3.53	2.49	1.42	0.70
Third week	3.73	2.48	1.50	0.66
Fourth week	3.63	2.47	1.47	0.68
Average for June	3.66	2.48	1.48	0.68
July.				
First week	3.50	2.41	1.45	0.70
Second week	3.60	2.40	1.50	0.66
Third week	3.64	2.39	1.52	0.66
Fourth week	3.65	2.33	1.57	0.64
Average for July	3.62	2.38	1.52	0.66
August.				
First week	3.73	2.29	1.63	0.61
Second week	3.73	2.29	1.63	0.61
Third week	3.79	2.35	1.61	0.62
Fourth week	3.99	2.38	1.67	0.60
Average for August	3.87	2.35	1.65	0.61

TABLE SHOWING RELATION OF CASEIN TO FAT, ETC.— (*Concluded*).

1893.	Per cent. of fat in milk.	Per cent. of casein in milk.	Pounds of fat for one pound of casein in milk.	Pounds of casein for one pound of fat in milk.
September.				
First week	4.03	2.46	1.64	0.61
Second week	4.00	2.51	1.59	0.63
Third week	4.00	2.59	1.54	0.65
Fourth week	4.20	2.72	1.54	0.65
Average for Sept ...	4.06	2.56	1.58	0.63
October.				
First week	4.20	2.76	1.52	0.66
Second week	4.22	2.74	1.54	0.65
Third week	4.40	2.81	1.57	0.64
Fourth week	4.24	2.75	1.54	0.65
Average for Oct	4.28	2.77	1.54	0.65

TABLE SHOWING POUNDS OF FAT FOR ONE POUND OF CASEIN IN NORMAL MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	1.41	1.42	1.39	1.43	1.41	1.38	....
Greatest	......	1.74	1.53	1.50	1.61	1.57	1.50	....
Average	......	1.62	1.47	1.45	1.53	1.50	1.44	1.50
1893.								
Stone's factory:								
Least	1.50	1.50	1.41	1.42	1.59	1.58	1.57	....
Greatest	1.51	1.54	1.56	1.59	1.65	1.63	1.62	....
Average	1.50	1.52	1.48	1.52	1.62	1.60	1.58	1.54
Merry's factory:								
Least	1.47	1.46	1.45	1.49	1.58	1.53	1.53	....
Greatest	1.55	1.56	1.55	1.59	1.71	1.61	1.62	....
Average	1.50	1.50	1.50	1.54	1.66	1.57	1.56	1.55
Forty-eight factories:								
Least	1.45	1.42	1.38	1.43	1.57	1.56	1.47	....
Greatest	1.53	1.60	1.57	1.55	1.78	1.69	1.56	....
Average	1.50	1.51	2.47	1.51	1.65	1.62	1.52	1.52
Average for 1893	1.50	1.51	1.48	1.52	1.65	1.59	1.55	1.53
Average for 1892 and 1893	1.50	1.53	1.48	1.49	1.60	1.56	1.50	1.52

TABULATED GENERAL SUMMARY.

Pounds of fat for one pound of casein in milk.

	Least.	Greatest.	Average
Season of 1892	1.38	1.74	1.50
Season of 1893:			
Stone's factory	1.41	1.65	1.54
Merry's factory	1.45	1.71	1.55
Forty-eight factories	1.38	1.78	1.52
Average for 1892 and 1893	......	......	1.52

a. In normal milk, which contained fat varying from 3.04 to 4.6 per cent, the casein varied from 1.93 to 3 per cent. The fat averaged 3.75 per cent and the casein 2.46 per cent.

b. In no case did the normal milk during the two seasons contain less than 1.38 pounds of fat for one pound of casein or more than 1.78 pounds of fat for one pound of casein.

c. Averaging the individual results of our two seasons' work as below, we can see how the variations were distributed:

POUNDS OF FAT FOR ONE POUND OF CASEIN IN NORMAL MILK.

	Below 1 35.	Between 1.35 and 1.40.	Between 1.40 and 1.45.	Between 1 45 and 1.50.	Between 1.50 and 1.55.	Between 1.55 and 1.60.	Between 1.60 and 1.65.	Between 1.65 and 1.70.	Between 1.70 and 1.75.	Between 1.75 and 1.80.
Number samples of milk	0	4	21	32	74	36	24	7	5	1

It will be seen that over eighty per cent of these results are within one-tenth of the average and, it is safe to say, that over ninety per cent would have been within these limits if the conditions of the past season had been normal.

d. During the first four months the average ratio was very nearly 1.5. The fat began to increase, relative to the casein, about the middle of July and continued throughout August; in September the ratio began to diminish and in October diminished still more, but did not return to its normal value. It will be remembered from what was stated above in connection with the casein that during July and August the fat increased while the casein did not increase at all but gradually decreased. This increase of fat relative to casein or decrease of casein relative to fat had the effect necessarily of diminishing the yield of cheese relative to the fat in the milk. The cheese-makers complained of the behavior of the cheese made at this time without understanding the cause of their difficulty. The cheese leaked fat badly and did not "stand up" well, although behaving perfectly when first made. The cheese in August contained an excess of fat, as we shall notice later. The cheese-makers were really dealing with milk which was not normal factory milk, but was like normal factory milk to which some cream had been added.

e. It appears from our results that, in case of mixed milk of herds of cows, the amount of fat seldom falls below 1.4 pounds for each pound of casein.

f. The question has been raised in regard to the relation of fat to casein in the milk of cows which are in about the same portion of their lactation period. It has been stated that, with different herds of cows in the same stage of lactation, the fat increases more rapidly than the casein. The results secured with the mixed milk of herds during the last season in the month of May may contribute something to our information upon this point. During May samples of milk were received containing fat varying from 3.3 to 4 per cent.

Arranging the results in the order of the fat-content of the milk, we have the following table:

TABLE SHOWING RELATION OF FAT TO CASEIN IN MILK FROM DIFFERENT FACTORIES IN MAY.

PER CENT OF FAT IN MILK.	Per cent of casein in milk.	Pounds of fat for one pound of casein in milk.
3.30	2.21	1.49
3.30	2.18	1.51
3.35	2.25	1.50
3.40	2.18	1.56
3.40	2.28	1.50
3.45	2.22	1.55
3.45	2.26	1.53
3.50	2.28	1.54
3.55	2.33	1.52
3.60	2.25	1.60
3.60	2.54	1.42
3.60	2.33	1.54
3.60	2.46	1.46
3.70	2.57	1.44
3.70	2.46	1.50
3.80	2.44	1.56
3.80	2.44	1.56
3.80	2.51	1.51
3.85	2.54	1.51
3.90	2.54	1.54
3.90	2.66	1.47
4.00	2.62	1.53
4.00	2.66	1.50
4.00	2.64	1.51

The results in the table above show that, while there was some variation, the marked and general tendency was a proportionate increase of fat and casein.

g. In making a comparison of the relation of fat to casein in the milk of the two herds of cows giving milk highest and lowest in fat-content at each factory considerable difficulty was met for the reason that, of the milks lowest in fat, some were undoubtedly skimmed. While all milks that showed positive evidence of skimming were omitted from the averages, yet some were probably included that had been skimmed some, and the results of comparing normal with skim-milk can not give us the facts sought. However, so far as our results go, they showed, for the season's average, comparatively little difference. The fact has also been brought out that we can not get conclusive evidence in regard to the relation of fat to casein by comparing the milk of different herds for one week or even for one month, but we must have the results of a season. Next season we hope to continue and extend our study of the milk of different herds of cows, especially with reference to the relation of fat to casein.

11. RELATION OF FAT TO CASEIN AND ALBUMEN IN NORMAL MILK.

So far as the relation of milk to cheese-making is concerned, we need only consider the fat and casein and their relation to each other; but, for the sake of comparison with other results where the casein and albumen have been determined together and not separately, it may be desirable to summarize our results showing the relation of fat to casein and albumen in normal milk.

TABLE SHOWING RELATION OF FAT TO CASEIN AND ALBUMEN IN NORMAL MILK.

1893.	Per cent of fat in milk.	Per cent of casein and albumen in milk.	Pounds of fat for one pound of casein and albumen in milk.	Pounds of casein and albumen for one pound of fat in milk.
April.				
First week	3.43	2.77	1.28	0.84
Second week	3.47	2.80	1.24	0.81
Third week	3.40	2.78	1.22	0.82
Average for April	3.43	2.81	1.22	0.82
May.				
First week	3.46	2.81	1.24	9.81
Second week	3.46	2.90	1.19	0.84
Third week	3.60	3.03	1.19	0.84
Fourth week	3.81	3.31	1.15	0.87
Average for May	3.67	3.11	1.18	0.85
June.				
First week	3.67	3.26	1.12	0.89
Second week	3.53	3.24	1.09	0.92
Third week	3.73	3.24	1.15	0.87
Fourth week	3.63	3.20	1.13	0.88
Average for June	3.66	3.23	1.13	0.88
July.				
First week	3.50	3.10	1.13	0.88
Second week	3.60	3.08	1.17	0.86
Third week	3.64	3.09	1.18	0.85
Fourth week	3.65	2.99	1.22	0.82
Average for July	3 62	3.06	1.18	0.86
August.				
First week	3.73	2.92	1.27	0.78
Second week	3.73	2.90	1.29	0.78
Third week	3.79	2.96	1.28	0.79
Fourth week	3.99	3.08	1.30	0.77
Average for August	3.87	3.01	1.29	0.78

TABLE SHOWING RELATION OF FAT TO CASEIN, ETC.—(*Concluded*).

1893.	Per cent of fat in milk.	Per cent of casein and albumen in milk.	Pounds of fat for one pound of casein and albumen in milk.	Pounds of casein and albumen for one pound of fat in milk.
September.				
First week	4.03	3.16	1.28	0.79
Second week	4.00	3.17	1.26	0.79
Third week	4.00	3.23	1.24	0.81
Fourth week	4.20	3 43	1.22	0.82
Average for Sept.	4.06	3.24	1.25	0.80
October.				
First week	4.20	3.47	1.21	0.83
Second week	4.22	3.43	1.23	0.81
Third week	4.40	3.52	1.25	0.80
Fourth week	4.24	3.47	1.22	0.82
Average for October.	4.28	3.48	1.23	0.81

TABULATED GENERAL SUMMARY.

	POUNDS OF FAT FOR ONE POUND OF CASEIN AND ALBUMEN IN MILK.		
	Least.	Greatest.	Average.
Season of 1892	1.07	1.33	1.18
Season of 1893:			
Stone's factory	1.09	1.32	1.21
Merry's factory	1.12	1.28	1.21
Forty-eight factories	1.06	1.33	1.19
Average for 1892 and 1893	.....	......	1.19

a. In normal milk, which contained fat varying from 3.04 to 4.6 per cent, the casein and albumen varied from 2.53 to 3.76 per cent. The fat averaged 3.75 per cent and the casein and albumen 3.14 per cent.

b. In no case did the normal milk, during the two seasons, contain less than 1.07 pounds of fat for one pound of casein and albumen or more than 1.33 pounds.

c. It appears from our results that, in the case of mixed milk of herds of cows, the amount of fat seldom falls below 1.1 pounds of fat for each pound of casein and albumen.

12. GENERAL SUMMARY OF RESULTS RELATING TO THE COMPOSITION OF NORMAL MILK.

1. *Pounds of total solids in* 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1882	11.47	13.91	12.64
Season of 1893	11.70	13.87	12.68
Seasons of 1892 and 1893	11.47	13.91	12.67

2. *Pounds of solids not fat in* 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	8.27	9.66	8.94
Season of 1893	8.40	9.35	8.91
Seasons of 1892 and 1893	8.27	9.66	8.92

3. *Pounds of cheese-producing solids (fat and casein) in* 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	4.97	7.35	6.16
Season of 1893	5.48	7.44	6.23
Seasons of 1892 and 1893	4.97	7.44	6.21

4. *Pounds of whey-solids (albumen, sugar, etc.) in* 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	6.11	7.03	6.48
Season of 1893	6.19	6.69	6.45
Seasons of 1892 and 1893	6.11	7.03	6.46

5. *Pounds of fat in* 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	3.04	4.35	3.69
Season of 1893	3.33	4.60	3.77
Seasons of 1892 and 1893	3.04	4.60	3.75

6. *Pounds of casein and albumen in* 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	2.53	3.76	3.13
Season of 1893	2.75	3.60	3.14
Seasons of 1892 and 1893	2.53	3.76	3.14

7. *Pounds of casein in 100 pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	1.93	3.00	2.47
Season of 1893	2.18	2.85	2.46
Seasons of 1892 and 1893	1.93	3.00	2.46

8. *Pounds of albumen in 100 pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	0.55	0.86	0.66
Season of 1893	0.47	0.87	0.68
Seasons of 1892 and 1893	0.47	0.87	0.68

9. *Pounds of casein for one pound of albumen in normal milk.*

	Least.	Greatest.	Average.
Season of 1892	2.60	4.60	3.74
Season of 1893	2.80	5.58	3.62
Seasons of 1892 and 1893	2.60	5.58	3.66

10. *Pounds of fat for one pound of casein in normal milk.*

	Least.	Greatest.	Average.
Season of 1892	1.38	1.74	1.50
Season of 1893	1.38	1.78	1.53
Seasons of 1892 and 1893	1.38	1.78	1.52

11. *Pounds of fat for one pound of casein and albumen in normal milk.*

	Least.	Greatest.	Average.
Season of 1892	1.07	1.33	1.18
Season of 1893	1.06	1.33	1.20
Seasons of 1892 and 1893	1.06	1.33	1.19

12. VARIATION IN THE COMPOSITION OF MILK DURING THE SEASON.

The changes that normally take place in milk with advance of lactation were quite seriously interfered with by the conditions of weather, since about the middle of July the pastures began to suffer from drouth. The general effect was rapidly to diminish the flow of milk, and the different constituents changed into abnormal relations. The fat increased, while the casein and albumen diminished, the albumen decreasing in larger relative proportion.

13. TABULATED MONTHLY AVERAGES SHOWING THE COMPOSITION OF MILK DURING THE FACTORY SEASON.

A. Table showing average composition of factory milk for the season of 1892.

MONTH.	Pounds of water in 100 lbs. of milk.	Pounds of total solids in 100 lbs. of milk.	Pounds of solids not fat in 100 lbs. of milk.	Pounds of fat in 100 lbs. of milk.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein in 100 lbs. of milk.	Pounds of albumen in 100 lbs. of milk.	Pounds of sugar ash, etc., in 100 lbs. of milk.
1892.								
May	88.08	11.92	8.72	3.20	2.65	2.00	0.65	6.07
June	87.47	12.53	8.95	3.58	3.25	2.44	0.81	5.70
July	87.40	12.60	8.97	3.63	3.08	2.51	0.57	5.89
August	87.31	12.69	8.92	3.77	3.04	2.46	0.58	5.88
September	87.45	12.55	8.74	3.81	3.12	2.53	0.59	5.62
October	86.42	13.58	9.44	4.14	3.66	2.88	0.78	5.78
Average for season	87.36	12.64	8.95	3.69	3.13	2.47	0.66	5.82

B. Table showing average composition of milk for season of 1893 at Mr. Stone's factory.

MONTH.	Pounds of water in 100 lbs. of milk	Pounds of total solids in 100 lbs of milk.	Pounds of solids not fat in 100 lbs of milk	Pounds of fat in 100 lbs. of milk.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein in 100 lbs. of milk.	Pounds of albumen in 100 lbs. of milk.	Pounds of sugar, ash, etc., in 100 lbs of milk.
1893.								
April	87.90	12.10	8.63	3.47	2.88	2.31	0.51	5.81
May	87.40	12.60	8.90	3.70	3.22	2.43	0.79	5.68
June	87.27	12.73	9.05	3.68	3.27	2.49	0.78	5.78
July	87.46	12.54	8.89	3.65	3.08	2.40	0.68	5.81
August	87.49	12.51	8.70	3.81	2.93	2.35	0.58	5.77
September	87.02	12.98	8.98	4.00	3.17	2.50	0.67	5.81
October	86.83	13.17	8.94	4.23	3.36	2.67	0.69	5.58
Average for season	87.34	12.66	8.88	3.78	3.12	2.45	0.67	5.76

C. *Table showing average composition of milk for season of* 1893 *at Mr. Merry's factory.*

MONTH.	Pounds of water in 100 lbs. of milk.	Pounds of total solids in 100 lbs. of milk.	Pounds of solids not fat in 100 lbs. of milk.	Pounds of fat in 100 lbs. of milk.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein in 100 lbs. of milk.	Pounds of albumen in 100 lbs. of milk.	Pounds of sugar, ash, etc. in 100 lbs. of milk.
1893.								
April	88.04	11.96	8.51	3.45	2.81	2.29	0.52	5.70
May	87.57	12.43	8.88	3.55	3.03	2.36	0.67	5.85
June	87.50	12.50	8.92	3.58	3.14	2.39	0.75	5.79
July	87.63	12.37	8.82	3.55	2.99	2.30	0.69	5.83
August	87.41	12.59	8.77	3.82	2.99	2.30	0.69	5.78
September	87.40	12.90	8.85	4.05	3.23	2.58	0.65	5.62
October	86.48	13.52	9.20	4.32	3.47	2.77	0.70	5.73
Average for season	87.38	12.62	8.86	3.76	3.11	2.43	0.68	5.75

D. Table showing average composition of milk during season of 1893 *at forty-eight factories.*

MONTH.	Pounds of water in 100 pounds of milk.	Pounds of total solids in 100 pounds of milk.	Pounds of solids not fat in 100 pounds of milk.	Pounds of fat in 100 pounds of milk.	Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of albumen in 100 pounds of milk.	Pounds of sugar, ash, etc in 100 pounds of milk.
1893.								
April	88.09	11.91	8.52	3.39	2.80	2.27	0.53	5.72
May	87.42	12.58	8.89	3.69	3.11	2.44	0.67	5.78
June	87.26	12.74	9.06	3.68	3.25	2.50	0.75	5.81
July	87.50	12.50	8.87	3.63	3.09	2.41	0.68	5.78
August	87.26	12.74	8.80	3.94	3.07	2.39	0.68	5.73
September	86.80	13.20	9.05	4.15	3.31	2.56	0.75	5.74
October	86.47	13.53	9.26	4.27	3.53	2.81	0.72	5.73
Average for season	87.28	12.72	8.95	3.77	3.17	2.48	0.69	5.78

E. Table showing average composition of milk during season of 1893 *at all factories.*

MONTH.	Pounds of water in 100 pounds of milk.	Pounds of total solids in 100 pounds of milk.	Pounds of solids not fat in 100 pounds of milk.	Pounds of fat in 100 pounds of milk	Pounds of casein and albumen in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of albumen in 100 pounds of milk.	Pounds of sugar, ash, etc , in 100 pounds of milk.
1893.								
April	88.02	11.98	8.55	3.43	2.81	2.29	0.52	5.74
May	87.44	12.56	8.89	3.67	3.11	2.43	0.68	5.78
June	87.31	12.69	9.03	3.66	3.23	2.48	0.75	5.80
July	87.52	12.48	8.86	3.62	3.06	2.38	0.68	5.80
August	87.37	12.63	8.76	3.87	3.01	2.35	0.66	5.75
September	87.00	13.00	8.94	4.06	3.24	2.56	0.68	5.70
October	86.55	13.45	9.17	4.28	3.48	2.77	0.71	5.69
Average for season	87.32	12.68	8.91	3.77	3.14	2.46	0.68	5.77

F. Table showing average composition of milk during the seasons of 1892 *and* 1893.

MONTH.	Pounds of water in 100 lbs. of milk.	Pounds of solids in 100 lbs. of milk.	Pounds of solids not fat in 100 lbs. of milk.	Pounds of fat in 100 lbs. of milk.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein in 100 lbs. of milk.	Pounds of albumen in 100 lbs. of milk.	Pounds of sugar, ash, etc., in 100 lbs. of milk,
1892–1893.								
April	88.02	11.98	8.55	3.43	2.81	2.29	0.52	5.74
May	87.57	12.43	8.55	3.58	3.02	2.34	0.68	5.83
June	87.36	12.64	9.00	3.64	3.24	2.74	0.77	5.76
July	87.48	12.52	8.90	3.62	3.07	2.43	0.64	5.83
August	87.35	12.65	8.81	3.84	3.02	2.39	0.61	5.79
September	87.26	12.86	8.88	3.98	3.20	2.55	0.65	5.68
October	86.50	13.50	9.27	4.23	3.55	2.81	0.74	5.73
Average for two seasons	87.33	12.67	8.92	3.75	3.14	2.46	0.68	5.78

V. The Composition of Whey During the Season.

We shall consider the following points in connection with our study of the composition of whey.

1. Pounds of solids in 100 pounds of whey.
2. Pounds of fat in 100 pounds of whey.
3. Pounds of casein and albumen in 100 pounds of whey.
4. Pounds of casein in 100 pounds of whey.
5. Pounds of albumen in 100 pounds of whey.
6. General summary.

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES OF COMPOSITION OF WHEY DURING THE SEASON.

1893.	Per cent. of water.	Per cent. of solids.	Per cent of solids, not fat.	Per cent of fat	Per cent of casein and albumen.	Per cent. of sugar, ash, etc.
April.						
Second week	93.17	6.83	6.50	0.33	0.76	5.74
Third week	93.11	6.89	6.45	0.44	0.74	5.71
Fourth week	93.22	6.78	6.38	0.40	0.70	5.68
Average for April	93.17	6.83	6.43	0.40	0.73	5.70
May.						
First week	93.10	6.90	6.50	0.40	0.74	5.76
Second week	93.05	6.95	6.57	0.38	0.80	5.77
Third week	93.04	6.96	6.54	0.42	0.81	5.73
Fourth week	93.92	7.08	6.67	0.41	0.91	5.76
Average for May	93.00	7.00	6.60	0.40	0.84	5.76
June.						
First week	92.98	7.02	6.68	0.34	0.89	5.79
Second week	92.96	7.04	6.68	0.36	0.88	5.80
Third week	92.95	7.05	6.70	0.35	0.90	5.80
Fourth week	93.05	6.95	6.68	0.27	0.87	5.81
Average for June	92.99	7.01	6.68	0.32	0.89	5.80
July.						
First week	92.98	7.02	6.71	0.31	0.83	5.88
Second week	93.08	6.92	6.57	0.35	0.81	5.76
Third week	93.01	6.99	6.62	0.37	0.85	5.77
Fourth week	93.06	6.94	6.56	0.38	0.79	5.77
Average for July	93.03	6.97	6.61	0.36	0.83	5.78
August.						
First week	93.11	6.89	6.54	0.35	0.72	5.82
Second week	93.00	7.00	6.60	0.40	0.76	5.84
Third week	93.14	6.86	6.47	0.39	0.80	5.68
Fourth week	93.06	6.94	6.54	0.40	0.82	5.72
Average for August	93.08	6.92	6.53	0.39	0.79	5.74

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES OF COMPOSITION, ETC.—(*Concluded*).

1893.	Per cent. of water.	Per cent. of solids.	Per cent. of solids, not fat.	Per cent. of fat.	Per cent. of casein and albumen.	Per cent. of sugar, ash, etc.
September.						
First week	93.05	6.95	6.49	0.46	0.86	5.63
Second week	93.04	6.96	6.54	0.42	0.84	5.70
Third week	93.02	6.98	6.62	0.36	0.88	5.74
Fourth week	92.92	7.08	6.62	0.46	0.92	5.70
Average for Sept	93.01	6 99	6.55	0.44	0.87	5.68
October.						
First week	92.87	7.13	6.73	0.40	0.99	5.74
Second week	92.75	7.25	6.75	0.50	0.99	5.76
Third week	92.94	7.06	6.64	0.42	0.96	5.68
Fourth week	92.94	7.06	6.67	0.39	0.95	5.73
Average for Oct	92.90	7.10	6.68	0.42	0.96	5.72

1. POUNDS OF SOLIDS IN 100 POUNDS OF WHEY.

1892.	April.	May	June.	July.	August.	September.	October.	Average for season.
Least	......	6.61	6.82	6.78	6.78	6.43	6.62	....
Greatest	......	7.52	7.13	7.20	7.08	6.98	6.93	....
Average	......	7.11	7.01	6.92	6.91	6.69	6.84	6.91
1893.								
Stone's factory:								
Least	6.88	7.00	6.95	6.88	6.80	6.98	......	......
Greatest	6 98	7.14	7.08	7.02	6.99	7.08	......	....
Average	6.93	7.07	7.01	6.96	6.87	7.03	......	6.98
Merry's factory:								
Least	6.75	6.95	6.94	6.87	6.87	6.81	......	....
Greatest	6.82	7.16	7.06	7.05	7.00	6.98	......	....
Average	6.79	7.02	6.99	6.94	6.93	6.92	.....	6.93
Forty-eight factories:								
Least	6.72	6.83	6.89	6.89	6.81	6.95	7.03	....
Greatest	6.86	7.25	7.16	7.04	7.07	7.21	7.25	....
Average	6.81	7.00	7.02	6.98	6.95	7.08	7.10	7.00
Average for 1893	6.83	7.00	7.01	6.97	6.92	6.99	7.10	6.97
Average for 1892 and 1893	6.83	7.02	7.01	6.95	6.92	6.82	6.96	6.96

TABULATED GENERAL SUMMARY.

Pounds of solids in 100 *pounds of whey.*

	Least.	Greatest.	Average.
Season of 1892	6.43	7.52	6.91
Season of 1893:			
Stone's factory	6.80	7.14	6.98
Merry's factory	6.75	7.16	6.93
Forty-eight factories	6.72	7.25	7.00
Average for 1892 and 1893	......	......	6.96

a. Taking the two seasons of 1892 and 1893, the amount of solids in 100 pounds of whey varied from 6.43 to 7.52 pounds and averaged 6.96 pounds.

b. The amount of solids in whey was least in April, when the amount of solids in milk was least and greatest in the latter part of the season, when the amount of milk-solids was greatest; but the variation from month to month was small.

2. POUNDS OF FAT IN 100 POUNDS OF WHEY.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	0.23	0.23	0.23	0.29	0.33	0.30	....
Greatest	......	0.39	0.38	0.50	0.40	0.45	0.41	....
Average	......	0.32	0.30	0.35	0.35	0.39	0.35	0.34
1893.								
Stone's factory:								
Least	0.43	0.41	0.29	0.34	0.35	0.51	......	....
Greatest	0.47	0.55	0.40	0.40	0.42	0.42	......	....
Average	0.45	0.49	0.35	0.38	0.39	0.46	......	0.42
Merry's factory:								
Least	0.35	0.30	0.27	0.29	0.35	0.36	......	....
Greatest	0.42	0.39	0.38	0.40	0.42	0.46	......	....
Average	0.39	0.35	0.32	0.34	0.39	0.42	......	0.37
Forty-eight factories:								
Least	0.32	0.34	0.24	0.31	0.35	0.40	0.35	....
Greatest	0.44	0.51	0.40	0.42	0.45	0.48	0.50	....
Average	0.37	0.40	0.32	0.36	0.39	0.44	0.42	0.38
Average for 1893	0.40	0.40	0.32	0.36	0.39	0.44	0.42	0.38
Average for 1892 and 1893	0.40	0.38	0.31	0.35	0.38	0.41	0.38	0.36

TABULATED GENERAL SUMMARY.

Pounds of fat in 100 pounds of whey.

	Least.	Greatest.	Average.
Season of 1892	0.23	0.50	0.34
Season of 1893:			
Stone's factory	0.29	0.55	0.42
Merry's factory	0.27	0.46	0.37
Forty-eight factories	0.24	0.51	0.38
Average for 1892 and 1893	......	......	0.36

a. During the seasons of 1892 and 1893, the amount of fat in 100 pounds of whey varied from 0.23 to 0.55 pounds and averaged 0.36 pounds.

b. The amount of fat in whey was greatest at the beginning and end of the season, being least in June and July.

3. POUNDS OF CASEIN AND ALBUMEN IN 100 POUNDS OF WHEY.

	April.	May.	June.	July.	August.	September.	October.	Average for season.
1892.								
Least	.....	0.67	0.84	0.78	0.80	0.77	0.87	.....
Greatest	.....	0.75	0.88	0.86	0.83	0.85	1.07	.....
Average	.....	0.70	0.86	0.82	0.81	0.83	1.00	0.84
1893. Stone's factory:								
Least	0.73	0.82	0.84	0.76	0.65	0.85	.....	.....
Greatest	0.75	0.96	0.91	0.85	0.81	0.86	.....	.....
Average	0.74	0.90	0.88	0.80	0.74	0.86	.....	0.82
Merry's factory:								
Least	0.71	0.76	0.84	0.80	0.78	0.84	.....	.....
Greatest	0.79	0.91	0.87	0.82	0.86	0.91	.....	.....
Average	0.75	0.83	0.85	0.81	0.81	0.87	.....	0.82
48 factories:								
Least	0.66	0.71	0.86	0.80	0.76	0.87	0.93	.....
Greatest	0.73	0.93	0.98	0.88	0.91	0.92	0.99	.....
Average	0.70	0.84	0.90	0.84	0.82	0.90	0.96	0.86
Average for 1893	0.73	0.84	0.89	0.83	0.79	0.87	0.96	0.84
Average for 1892 and 1893	0.73	0.81	0.88	0.83	0.80	0.85	0.98	0.84

Tabulated general summary.

	POUNDS OF CASEIN AND ALBUMEN IN 100 POUNDS OF WHEY.		
	Least.	Greatest.	Average.
Season of 1892	0.67	1.07	0.84
Season of 1893:			
Stone's factory	0.65	0.96	0.82
Merry's factory	0.71	0.91	0.82
Forty-eight factories	0.66	0.98	0.86
Average for 1892 and 1893	......	......	0.84

a. During the two seasons of 1892 and 1893, the amount of casein and albumen in 100 pounds of whey varied from 0.65 to 1.07 lbs. and averaged 0.84 lbs.

b. The amount of albumen in whey was smallest at the beginning of the season and greatest at the end; the variation was governed mainly by the amount of albumen in milk.

4. POUNDS OF CASEIN IN 100 POUNDS OF WHEY.

The presence of casein in the whey is due to two causes. First, it is due to the passage of very fine particles of coagulated casein through the strainer, when the whey is drawn from the curd. These minute particles can readily be seen by letting a pail of freshly-drawn whey stand until the casein settles, and then pouring off the whey, when a noticeable quantity of finely divided casein can be seen at the bottom of the pail. This passage of casein into the whey is not entirely avoidable, but it is needlessly made greater by carelessness or violence in cutting the curd and in subsequent handling, by agitation while drawing off the whey and by imperfect strainers. *The amount of casein that thus passes into the whey varied from* 0.04 *to* 0.16 *lbs. and averaged* 0.09 *lbs. in* 100 *pounds of whey.*

In addition to the casein that passes into the whey mechanically, a small quantity appears in the whey as a result of the chemical action of the rennet. According to the best light we now have upon the subject, it appears that when the casein of milk is acted upon by rennet, it is converted into two different compounds; one of these, constituting the greater portion, is insoluble and forms the solid portion of the curd proper; while the other, which is usually small in quantity, is soluble and passes into the whey along with the albumen, which it resembles in several respects. The amount of this soluble portion depends upon conditions which have not yet been carefully studied; in amount, it does not probably exceed 0.05 lbs. in 100 pounds of whey. Hence, the total amount of casein, insoluble and soluble, present in the whey probably does not exceed, on an average, 0.15 lbs. in 100 pounds of whey. We have as yet no method for determining the amount of soluble casein in the presence of albumen and, therefore, we can not now present definite data on this point.

5. POUNDS OF ALBUMEN IN 100 POUNDS OF WHEY.

If 100 pounds of whey contain, on an average, 0.15 pounds casein, there will be contained in the same amount of whey from 0.5 pounds to 0.92 pounds of albumen, with an average of 0.7 pounds.

6. GENERAL SUMMARY OF RESULTS RELATING TO THE COMPOSITION OF WHEY.

1. *Pounds of solids in* 100 *pounds of whey.*

	Least.	Greatest.	Average.
Season of 1892........................	6.43	7.52	6.91
Season of 1893........................	6.72	7.25	6.97
Seasons of 1892 and 1893	6.43	7.52	6.96

2. *Pounds of fat in* 100 *pounds of whey.*

	Least.	Greatest.	Average.
Season of 1892........................	0.23	0.50	0.34
Season of 1893..	0.24	0.55	0.38
Seasons of 1892 and 1893................	0.23	0.55	0.36

3. *Pounds of casein and albumen in* 100 *pounds of whey.*

	Least.	Greatest.	Average.
Season of 1892........................	0.67	1.07	0.84
Season of 1893........................	0.65	0.99	0.84
Seasons of 1892 and 1893................	0.65	1.07	0.84

4. *Tabulated monthly averages showing composition of whey.*

A. TABLE SHOWING AVERAGE COMPOSITION OF WHEY FOR THE SEASON OF 1892.

MONTH.	Pounds of water in 100 lbs. of whey.	Pounds of total solids in 100 lbs. of whey.	Pounds of fat in 100 lbs. of whey.	Pounds of casein and albumen in 100 lbs. of whey.	Pounds of sugar, ash, etc., in 100 lbs. of whey.
1892.					
Fact'y experiments:					
May	92.89	7.11	0.32	0.70	6.09
June	92.99	7.01	0.30	0.86	5.85
July.	93.08	6.92	0.35	0.82	5.75
August	93.09	6.91	0.35	0.81	5.75
September...........	93.31	6.69	0.39	0.83	5.47
October.............	93.16	6.84	0.35	1.00	5.49
Average for season.	93.09	6.91	0.34	0.84	5.73

B. TABLE SHOWING AVERAGE COMPOSITION OF WHEY DURING THE SEASON OF 1893 AT MR. STONE'S FACTORY.

MONTH.	Pounds of water in 100 lbs. of whey.	Pounds of total solids in 100 lbs. of whey.	Pounds of fat in 100 lbs. of whey.	Pounds of casein and albumen in 100 lbs. of whey.	Pounds of sugar, ash, etc , in 100 lbs. of whey.
1893.					
April	93.07	6.93	0.45	0.74	5.74
May	92.93	7.07	0.49	0.90	5.68
June	92.99	7.01	0.35	0.88	5.78
July	93.04	6.96	0.38	0.80	5.78
August	93.13	6.87	0.39	0.74	5.74
September	92.97	7.03	0.46	0.86	5.71
Average for season	93.02	6.98	0.42	0.82	5.74

C. TABLE SHOWING AVERAGE COMPOSITION OF WHEY DURING THE SEASON OF 1893 AT MR. MERRY'S FACTORY.

MONTH.	Pounds of water in 100 lbs. of whey.	Pounds of solids in 100 lbs. of whey.	Pounds of fat in 100 lbs. of whey.	Pounds of casein and albumen in 100 lbs. of whey.	Pounds in sugar, ash, etc., in 100 lbs. of whey.
1893.					
April	93.21	6.79	0.39	0.75	5.65
May	92.98	7.02	0.35	0.83	5.84
June	93.01	6.99	0.32	0.85	5.82
July	93.06	6.94	0.34	0.81	5.79
August	93.07	6.93	0.39	0.81	5.73
September	93.08	6.92	0.42	0.87	5.63
Average for season	93.07	6.93	0.37	0.82	5.74

D. TABLE SHOWING AVERAGE COMPOSITION OF WHEY DURING THE SEASON OF 1893 AT FORTY-EIGHT FACTORIES.

MONTH.	Pounds of water in 100 lbs. of whey.	Pounds of solids in 100 lbs. of whey.	Pounds of solids not fat in 100 lbs. of whey.	Pounds of fat in 100 lbs. of whey.	Pounds of casein and albumen in 100 lbs. of whey.	Pounds of sugar, ash, etc., in 100 lbs. of whey.
1893.						
April	93.19	6.81	6.44	0.37	0.70	5.74
May	93.00	7.00	6.60	0.40	0.84	5.76
June	92.98	7.02	6.70	0.32	0.90	5.80
July	93.02	6.98	6.62	0.36	0.84	5.78
August	93.05	6.95	6.56	0.39	0.82	5.74
September	92.92	7.08	6.64	0.44	0.90	5.74
October	92.90	7.10	6.69	0.41	0.96	5.73
Aver. for season	93.00	7.00	6.62	0.38	0.86	5.76

E. TABLE SHOWING AVERAGE COMPOSITION OF WHEY DURING THE SEASON OF 1893 AT ALL FACTORIES.

MONTH.	Pounds of water in 100 lbs. of whey.	Pounds of solids in 100 lbs. of whey.	Pounds of fat in 100 lbs. of whey.	Pounds of casein and albumen in 100 lbs. of whey.	Pounds of sugar, ash, etc., in 100 lbs. of whey.
1893.					
April	93.17	6.83	0.40	0.73	5.70
May	93.00	7.00	0.40	0.84	5.76
June	92.99	7.01	0.32	0.89	5.80
July	93.03	6.97	0.36	0.83	5.78
August	93.08	6.92	0.39	0.79	5.74
September	93.01	6.99	0.44	0.87	5.68
October	92.90	7.10	0.42	0.96	5.72
Aver. for season	93.03	6.97	0.38	0.84	5.75

F. TABLE SHOWING AVERAGE COMPOSITION OF WHEY DURING THE SEASONS OF 1892 AND 1893.

MONTH.	Pounds of water in 100 lbs. of whey.	Pounds of solids in 100 lbs. of whey.	Pounds of fat in 100 lbs. of whey.	Pounds of casein and albumen in 100 lbs. of whey.	Pounds of sugar, ash, etc.. in 100 lbs. of whey.
1892–1893.					
April	93.17	6.83	0.40	0.73	5.70
May	92.98	7.02	0.38	0.81	5.83
June	92.99	7.01	0.31	0.88	5.82
July	93.05	6.95	0.35	0.83	5.77
August	93.08	6.92	0.38	0.80	5.74
September	93.18	6.82	0.41	0.85	5.56
October	96.04	6.96	0.38	0.98	5.60
Avg. for two seasons	93.04	6.96	0.36	0.84	5.76

VI. The Composition of Green Cheese During the Season.

The following points will be presented in connection with our discussion of the composition of green cheese:

1. Pounds of water in 100 pounds of green cheese.
2. Pounds of solids in 100 pounds of green cheese.
3. Pounds of fat in 100 pounds of green cheese.
4. Pounds of casein in 100 pounds of green cheese.
5. Relation of fat to casein in cheese.
6. Relation of fat to solids not fat in cheese.
7. General summary.

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES OF COMPOSITION OF GREEN CHEESE DURING THE SEASON.

1893	Per cent of water.	Per cent of total solids.	Per cent of solids not fat.	Per cent of fat.	Per cent of casein.	Per cent of sugar, ash, etc.
April.						
Second week	38.06	61.94	28.57	33.37	23.24	5.33
Third	37.93	62.07	29.27	32.80	22.75	6.52
Fourth week	38.01	61.99	29.16	32.83	23.11	6.05
Average for April.	38.00	62.00	29.06	32.94	23.02	6.04
May.						
First week	39.70	60.30	28.40	31.90	22.02	6.38
Second week	37.73	62.27	29.11	33.16	23.06	6.05
Third week	35.49	64.51	30.40	34.11	24.36	6.04
Fourth week	36.50	63.50	30.10	33.40	24.18	5.92
Average for May.	37.12	62.88	29.66	33.22	23.62	6.04
June.						
First week	35.61	64.39	30.69	33.70	24.68	6.01
Second week	35.42	64.58	31.25	33.33	25.42	5.83
Third week	35.92	64.08	30.05	34.03	24.18	5.87
Fourth week	36.43	63.57	29.74	33.83	24.15	5.59
Average for June.	35.92	64.08	30.30	33.78	24.48	5.82
July.						
First week	36.12	63.88	30.27	33.61	24.53	5.74
Second week	36.20	63.80	30.26	33.54	24.04	6.23
Third week	37.49	62.51	29.24	33.27	23.32	5.92
Fourth week	36.76	63.24	29.24	34.00	23.40	5.84
Average for July.	36.93	63.07	29.54	33.53	23.61	5.93
August.						
First week	37.54	62.46	28.50	33.96	22.54	5.96
Second week	36.09	63.91	29.06	34.85	22.85	6.21
Third week	38.14	61.86	28.14	33.72	21.96	6.18
Fourth week	36.79	63.21	28.34	34.87	22.57	5.77
Average for Aug.	37.16	62.84	28.40	34.44	22.44	5.96

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES OF COMPOSITION OF GREEN CHEESE.—(*Concluded*).

1893.	Per cent of water.	Per cent of total solids.	Per cent of solids not fat.	Per cent of fat.	Per cent of casein.	Per cent of sugar, ash, etc.
September.						
First week.........	38.00	62.00	28.45	33.55	22.15	6.30
Second week.......	35.56	64.44	29.36	35.08	23.45	5.91
Third week........	37.41	62.59	28.00	34.59	22.93	5.07
Fourth week.......	37.33	62.67	28.98	33.69	23.20	5.78
Average for Sept.	37.15	62.85	28.75	34.10	22.83	5.92
October.						
First week.........	36.14	63.86	29.42	34.44	23.23	6.19
Second week.......	36.81	63.19	29.47	33.72	23.18	6.29
Third week........	36.56	61.44	28.22	33.22	22.54	5.68
Fourth week.......	40.08	59.92	27.87	32.05	22.30	5.57
Average for Oct..	38.62	61.38	28.42	32.96	22.63	5.79

1. POUNDS OF WATER IN 100 POUNDS OF CHEESE.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	36.47	35.27	33.94	33.50	34.46	36.21	....
Greatest	......	37.02	38.63	36.25	38.00	38.00	38.80	....
Average	......	37.10	36.82	34.90	36.29	36.29	37.62	36.41
1893.								
Stone's factory:								
Least	37.03	35.23	32.69	34.89	35.76	34.15	......	....
Greatest	39.24	37.98	36.78	37.50	38.49	38.38	......	....
Average	38.14	36.37	34.50	36.37	37.48	36.26	......	36.52
Merry's factory:								
Least	36.96	34.00	36.07	35.98	35.40	36.64	......	....
Greatest	37.52	39.00	37.53	36.46	37.37	37.41	......	....
Average	37.26	36.84	36.89	36.52	36.46	37.09	......	36.84
Forty-eight factories:								
Least	37.90	33.23	33.16	35.66	34.93	38.05	36.11	....
Greatest	38.84	40.47	38.20	38.86	40.17	38.26	43.89	....
Average	38.45	37.25	36.06	37.44	37.54	38.15	38.62	37.33
Average for 1893	38.00	37.12	35.92	36.93	37.16	37.15	38.62	37.05
Average for 1892 and 1893	38.00	37.11	36.22	36.25	36.69	36.83	38.29	26.84

TABULATED GENERAL SUMMARY.

Pounds of water in 100 pounds of green cheese.

	Least.	Greatest.	Average.
Season of 1892	33.50	38.80	36.41
Season of 1893:			
Stone's factory	32.69	39.24	36.52
Merry's factory	34.00	39.00	36.84
Forty-eight factories	33.16	43.89	37.33
Average for 1892 and 1893	......	......	36.84

a. During the seasons of 1892 and 1893, the amount of water in 100 pounds of green cheese varied from 32.69 to 43.89 pounds and averaged 36.82 pounds.

b. It will be noticed that the cheese made in the first and last portions of the season contain more water. This is doubtless due to the fact that the cheese made then are for home trade and these require a larger amount of moisture than those made for exporting.

2. POUNDS OF SOLIDS IN 100 POUNDS OF GREEN CHEESE.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	62.08	61.37	63.75	61.49	62.00	61.20	......
Greatest	......	63.53	64.73	66.06	66.50	65.54	63.79	......
Average	......	62.90	63.18	65.10	64.26	63.71	62.38	63.59
1893.								
Stone's factory:								
Least	60.76	62.02	63.22	62.50	61.55	61.62	......	......
Greatest	62.97	64.77	67.31	65.11	64.24	65.85	......	......
Average	61.86	63.63	65.50	63 63	62.52	63.74	......	63.48
Merry's factory:								
Least	62.48	61.00	62.47	62.54	62.63	62.59	......	......
Greatest	63.04	66.00	62.95	64.00	64.60	63.36	......	......
Average	62.74	63.16	63.11	63.54	63.54	62.91	......	63.16
Forty-eight factories:								
Least	61.16	59.53	61.80	61.14	59.83	61.74	56.11	......
Greatest	62.10	66.67	66.84	64.34	65.07	61.95	63.89	......
Average	61.55	62.75	63.94	62.56	62.46	61.85	61.38	62.67
Average for 1892	62.00	62.88	64.08	63.07	62.84	62.85	61.38	62.95
Average for 1892 and 1893	62.00	62.89	63.78	63.75	63.31	63.14	61.71	63.16

TABULATED GENERAL SUMMARY.

Pounds of solids in 100 *pounds of green cheese.*

	Least.	Greatest.	Average.
Season of 1892	61.20	66.50	63.59
Season of 1893:			
Stone's factory	60.76	67.31	63.48
Merry's factory	61.00	66.00	63.16
Forty-eight factories	56.11	66.84	62.67
Average for 1892 and 1893	......	......	63.16

a. During the seasons of 1892 and 1893, the amount of solids in 100 pounds of green cheese varied from 56.11 to 67.31 pounds and averaged 63.18 pounds.

b. The variation of solids is, of course, the same in amount as that of the water in cheese, the solids increasing in proportion as the water diminishes, and vice versa. As this increase and decrease of solids is divided among several constituents, it is not important to discuss their variation as a whole.

3. POUNDS OF FAT IN 100 POUNDS OF GREEN CHEESE.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	32.44	32.72	32.12	32.67	24.52	31.90	....
Greatest	......	35.64	34.90	35.96	36.64	36.79	34.60	....
Average	......	34.00	33.80	34.19	35.14	35.63	33.03	34.30
1893.								
Stone's factory:								
Least	32.07	32.32	33.20	33.17	33.62	32.90	......	....
Greatest	33.08	33.84	35.54	34.01	35.03	35.32	......	....
Average	32.58	33.27	34.30	33.64	34.22	34.11	......	33.69
Merry's factory:								
Least	33.30	32.42	33.00	33.37	34.01	33.90	......	....
Greatest	33.66	34.50	34.04	34.42	35.98	34.87	......	....
Average	33.52	33.58	33.48	33.79	34.68	34.35	......	33.90
Forty-eight factories:								
Least	32.36	31.39	31.96	32.55	32.13	34.45	30.00	....
Greatest	32.91	35.45	35.80	34.12	35.89	33.91	34.50	....
Average	32.68	33.18	33.72	33.28	34.41	33.68	33.02	33.41
Average for 1893	32.94	33.32	33.78	33.53	34.44	34.10	32.96	33.59
Average for 1892 and 1893	32.94	33.48	33.79	33.75	34.67	34.60	32.98	33.83

TABULATED GENERAL SUMMARY.

Pounds of fat in 100 *pounds of green cheese.*

	Least.	Greatest.	Average.
Season of 1892	31.90	36.79	34.30
Season of 1893:			
Stone's factory	32.07	35.54	33.69
Merry's factory	33.00	35.98	33.90
Forty-eight factories	30.00	35.89	33.41
Average for 1892 and 1893	......	......	33.83

a. During the seasons of 1892 and 1893, the amount of fat in 100 pounds of green cheese varied from 30 to 36.79 pounds and averaged 33.83 pounds. It will be noticed that at Mr. Merry's factory there was greater uniformity than in other cases.

b. The variation of monthly averages was not great. The variation was due in part to variation in the amount of water retained in the cheese and in part to the effect of the drought during July and August, 1893. We shall later discuss the question as to whether it is desirable to fix the legal limit to the amount of water that cheese may contain.

4. POUNDS OF CASEIN IN 100 POUNDS OF GREEN CHEESE.

1892.	April.	May.	June.	July.	August.	September.	October.	*Average for season.
Least	......	23.18	23.50	23.74	23.18	23.43	23.25	....
Greatest	......	24.10	26.10	24.75	25.51	24.90	24.14	....
Average	......	23.60	25.17	24.66	24.24	24.26	23.85	24.30
1893.								
Stone's factory:								
Least	22.03	24.34	24.55	23.12	21.78	21.94	......	....
Greatest	23.52	25.08	26.11	25.03	23.28	23.90	......	....
Average	22.77	24.72	25.22	24.05	22.38	22.92	......	23.68
Merry's factory:								
Least	22.78	22.70	23.80	23.22	22.10	22.57	......	....
Greatest	23.34	24.70	24.62	24.03	22.98	23.41	......	....
Average	23.09	23.65	24.06	23.57	22.59	22.93	......	23.32
Forty-eight factories:								
Least	22.55	21.31	23.15	22.78	21.54	22.02	20.80	....
Greatest	23.52	24.97	25.48	24.05	23.51	23.01	23.65	....
Average	23.17	23.51	24.35	23.41	22.41	22.52	22.63	23.39
Average for 1893	23.02	23.62	24.48	23.61	22.44	22.83	22.63	23.43
Average for 1892 and 1893	23.02	23.61	24.71	23.96	23.04	23.30	23.04	23.72

TABULATED GENERAL SUMMARY.

I ounds of casein in 100 pounds of green cheese.

	Least.	Greatest.	Average.
Season of 1892	23.18	26.10	24.30
Season of 1893:			
Stone's factory	21.78	26.11	23.68
Merry's factory	22.10	24.70	23.32
Forty-eight factories	20.80	25.48	23.39
Average for 1892 and 1893	......	......	23.72

a. During the seasons of 1892 and 1893 the amount of casein in 100 pounds of green chese varied from 20.8 to 26.11 pounds and averaged 23.72 pounds.

b. The variation from month to month was less than in case of the fat and was caused by the same conditions that produced the variation in fat.

By casein is meant all the nitrogen compounds of the cheese, whether soluble or insoluble. The soluble and insoluble portions of the nitrogen compounds were determined separately in 1892, but not in 1893, since nothing new was to be learned by their further determination. For the results of the work done in 1892 relating to soluble and insoluble casein in green cheese, see Bulletin 50, pages 62–3.

5. RELATION OF FAT TO CASEIN IN CHEESE MADE FROM NORMAL MILK.

Since the amount of albumen in cheese is very small we can properly speak of the nitrogen compounds in cheese as consisting of casein, as we have done above and shall continue to do in studying the composition of green cheese.

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES OF POUNDS OF FAT FOR ONE POUND OF CASEIN.

1893.	Pounds of fat in 100 pounds of cheese.	Pounds of casein in 100 pounds of cheese.	Pounds of fat for one pound of casein in cheese.
April:			
Second week	33.37	23.24	1.44
Third week	32.80	22.75	1.44
Fourth week	32.83	23.11	1.42
Average for April	32.94	23.02	1.43
May:			
First week	31.90	22.02	1.45
Second week	33.16	23.06	1.43
Third week	34.11	24.36	1.40
Fourth week	33.40	24.18	1.38
Average for May	33.22	23.62	1.41
June:			
First week	33.70	24.68	1.37
Second week	33.33	25.42	1.31
Third week	34.03	24.18	1.41
Fourth week	33.83	24.15	1.40
Average for June	33.78	24.48	1.38
July:			
First week	33.61	24.53	1.37
Second week	33.54	24.03	1.40
Third week	33.27	23.32	1.44
Fourth week	34.00	23.40	1.45
Average for July	33.53	23.61	1.42
August:			
First week	33.96	22.54	1.51
Second week	34.85	22.85	1.52
Third week	33.72	21.96	1.53
Fourth week	34.87	22.57	1.54
Average for August	34.44	22.44	1.53

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES OF POUNDS OF FAT FOR ONE POUND OF CASEIN — (*Concluded*).

1893.	Pounds of fat in 100 pounds of cheese.	Pounds of casein in 100 pounds of cheese.	Pounds of fat for one pound of casein in cheese.
September:			
First week	33.55	22.15	1.51
Second week	35.08	23.45	1.50
Third week	34.59	22.93	1.50
Fourth week	33.69	23.20	1.45
Average for September	34.10	22.83	1.49
October:			
First week	34.44	23.23	1.48
Second week	33.72	23.18	1.45
Third week	33.22	22.54	1.47
Fourth week	32.05	22.30	1.44
Average for October	32.96	22.63	1.46

TABLE SHOWING POUNDS OF FAT FOR ONE POUND OF CASEIN IN CHEESE MADE FROM NORMAL MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	.....	1.37	1.27	1.30	1.38	1.41	1.33	....
Greatest	....	1.52	1.40	1.45	1.54	1.51	1.44	....
Average	......	1.45	1.35	1.39	1.45	1.47	1.38	1.41
1893.								
Stone's factory:								
Least	1.41	1.33	1.30	1.34	1.50	1.48	.....	....
Greatest	1.46	1.36	1.41	1.47	1.57	1,50	......	....
Average	1.43	1.35	1.36	1.40	1.53	1.49	......	1.42
Merry's factory:								
Least	1.44	1.37	1.37	1.39	1.50	1.45	......	....
Greatest	1.46	1.49	1.41	1.46	1.59	1.53	......	....
Average	1.45	1.42	1.39	1.43	1.53	1.50	......	1.45
Forty-eight factories:								
Least	1.39	1.33	1.27	1.38	1.48	1.45	1.41	....
Greatest	1.44	1.48	1.45	1.47	1.60	1.54	1.48	....
Average	1.4	1.41	1.38	1.42	1.53	1.50	1.46	1.43
Average for 1893	1.43	1.41	1.38	1.42	1.53	1.50	1.46	1.43
Average for 1892 and 1893	1.43	1.42	1.38	1.41	1.50	1.48	1.43	1.42

Tabulated General Summary.

Pounds of fat for one pound of casein in cheese.

	Least.	Greatest.	Average.
Season of 1892	1.27	1.54	1.41
Season of 1893 :			
Stone's factory	1.30	1.57	1.42
Merry's factory	1.37	1.59	1.45
Forty-eight factories	1.27	1.60	1.43
Average for 1892 and 1893	......	......	1.42

a. The amount of fat for one pound of casein in cheese made from normal milk varied from 1.27 to 1.6 pounds and averaged 1.42 pounds during the seasons of 1892 and 1893.

b. In only ten cases, once in 1892 and once in 1893, did cheese made from normal milk contain less than 1.3 pounds of fat for one pound of casein and in no case was the ratio below 1.27.

c. Averaging the individual results of the two seasons' work as below, we can see how the variations were distributed:

Pounds of Fat for One Pound of Casein in Cheese Made from Normal Milk.

	Below 1.27.	Between 1.27 and 1.30.	Between 1.30 and 1.35.	Between 1.35 and 1.40.	Between 1.40 and 1.45.	Between 1.45 and 1.50.	Between 1.50 and 1.55.	Between 1.55 and 1.60.	Above 1.60.
Number samples of cheese	0	2	11	37	57	40	39	10	0

It will be seen that nearly 90 per cent of the results are within one-tenth of the average and the variation would have been within still narrower limits had it not been for the abnormal conditions prevailing in July and August.

d. From the results of our two years' work it appears fairly settled that, in the case of cheese made from the normal mixed milk of herds of cows, the fat seldom falls below 1.3 pounds for one pound of casein. The special bearing that this fact has upon the identification of cheese made from skimmed milk will be considered later.

6. Relation of Fat to Total Solids and to Solids not Fat in Cheese Made from Normal Milk.

We have seen from our previous work that the relation of fat to casein in cheese furnishes a means of distinguishing skim-milk cheese from whole-milk cheese. The question arises as to whether we can find other relations between the constituents of cheese which promise a more satisfactory basis for making such distinction. A careful study has been made of every experiment during the two seasons of the relation existing between the fat and total solids, of the relation existing between the fat and the solids not fat, and also of the relation existing between the total solids and the solids not fat. The result of the study has not appeared to furnish an equally satisfactory basis for distinguishing whole-milk from skim-milk cheese, and yet, since these relations are used in some States to define a whole-milk and skim-milk cheese, it is desirable to study the data furnished by our extended work in order to see how accurate such definitions are. In the table below, the heading of the fourth column of figures, "Pounds of fat in 100 pounds of cheese solids," is the same as pounds of fat in water-free cheese, that is, in cheese after the water has been removed by drying, leaving only the solids to consider. The figures in the fifth column also refer to water-free cheese. The advantage of expressing the results in this form is that the variable constituent, water, is removed, and a basis of comparison is established that is uniform.

TABLE SHOWING POUNDS OF FAT IN 100 POUNDS OF CHEESE-SOLIDS.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	52.25	51.96	50.39	53.13	54.79	51.80	....
Greatest	......	56.10	54.85	54.44	55.81	56.83	54.30	....
Average	......	54.05	53.40	52.52	54.69	55.93	52.95	53.94
1893.								
Stone's factory:								
Least	52.53	51.97	51.26	51.68	54.12	53.39	......	....
Greatest	52.78	52.79	52.91	53.92	55.66	53.64	......	....
Average	52.67	52.29	52.37	52.87	54.73	53.51	......	53.07
Merry's factory:								
Least	53.12	52.08	52.30	52.67	53.94	53.74	......	....
Greatest	53.87	54.61	53.47	53.78	55.67	55.35	......	....
Average	53.43	53.17	53.05	53.23	54.58	54.60	.....	53.68
Forty-eight factories:								
Least	52.74	51.10	51.01	52.43	53.70	54.00	53.36	....
Greatest	53.48	54.10	54.02	54.19	56.15	54.92	54.15	....
Average	53.10	52.88	52.74	53.20	55.09	54.45	53.77	53.31
Average for 1893	53.13	52.83	52.72	53.16	54.81	54.25	53.70	53.36
Average for 1892 and 1893	53.13	53.24	52.97	52.94	54.76	54.80	53.44	53.56

TABULATED GENERAL SUMMARY.

Pounds of fat in 100 *pounds of cheese-solids.*

	Least.	Greatest.	Average.
Season of 1892	50.39	56.83	53.94
Season of 1893:			
Stone's factory	51.26	55.66	53.07
Merry's factory	52.08	55.67	53.68
Forty-eight factories	51.01	56.15	53.31
Average for 1892 and 1893	......	......	53.56

a. During the seasons of 1892 and 1893, the amount of fat in 100 pounds of cheese-solids (or water-free cheese) varied from 50.39 to 56.83 pounds, and averaged 53.56 pounds.

b. The variation from month to month was not great. The general results go to show that in cheese made from normal milk, the amount of fat should never be less than 50 per cent of the cheese-solids, and that cheese containing less than this proportion of fat has undoubtedly been made from skimmed milk.

TABLE SHOWING POUNDS OF SOLIDS NOT FAT IN 100 POUNDS OF CHEESE-SOLIDS.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	43.90	45.15	45.56	44.19	43.17	45.70	....
Greatest	......	47.75	48.04	49.61	46.87	45.21	48.20	....
Average	......	45.95	46.60	47.48	45.31	44.07	47.05	46.06
1893.								
Stone's factory:								
Least	47.22	47.21	47.09	46.08	44.34	46.36	......	....
Greatest	47.44	48.03	48.74	48.32	45.88	46.61	......	....
Average	47.33	47.71	47.63	47.13	45.27	46.46	......	46.93
Merry's factory:								
Least	46.13	45.39	46.53	46.22	44.33	44.65	......	....
Greatest	46.88	47.92	47.70	47.33	46.06	46.26	......	....
Average	46.57	46.83	46.95	46.77	45.42	45.40	......	46.32
Forty-eight factories:								
Least	46.52	45.90	45.98	45.81	43.85	45.08	45.85	....
Greatest	47.26	48.90	48.99	47.57	46.30	46.00	46.64	......
Average	46.90	47.12	47.26	46.80	44.91	45.55	46.23	46.69
Average for 1893	46.87	47.17	47.28	46.84	45.19	45.75	46.30	46.64
Average for 1892 and 1893	46.87	46.76	47.03	47.06	45.24	45.20	46.56	46.44

Tabulated general summary.

	POUNDS OF SOLIDS NOT FAT IN 100 POUNDS OF CHEESE-SOLIDS		
	Least.	Greatest.	Average.
Season of 1892	43.17	49.61	46.06
Season of 1893:			
Stone's factory	44.34	48.74	46.93
Merry's factory	44.33	47.92	46.32
Forty-eight factories	43.85	48.99	46.69
Average for 1892 and 1893	....	....	46.44

a. During the seasons of 1892 and 1893, the amount of solids not fat (casein, ash, etc.) in 100 pounds of cheese-solids varied from 43.17 to 49.61 pounds. and averaged 46.44.

b. The general results go to show that, in cheese made from normal milk, the amount of solids not fat (casein, ash, etc.) should never be as much as 50 per cent of the entire cheese-solids, and that cheese containing more than this proportion of solids not fat has been made from skimmed milk.

TABLE SHOWING POUNDS OF FAT FOR ONE POUND OF SOLIDS NOT FAT IN CHEESE.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	1.10	1.08	1.01	1.14	1.21	1.08	....
Greatest	......	1.28	1.22	1.19	1.26	1.32	1.19	....
Average	......	1.18	1.15	1.11	1.21	1.27	1.13	1.17
1893.								
Stone's factory:								
Least	1.11	1.08	1.05	1.07	1.18	1.15	......	....
Greatest	1.12	1.12	1.12	1.16	1.25	1.16	......	....
Average	1.11	1.10	1.10	1.12	1.21	1.16	......	1.13
Merry's factory:								
Least	1.13	1.09	1.10	1.11	1.17	1.16	......	....
Greatest	1.17	1.20	1.15	1.16	1.26	1.24	......	....
Average	1.15	1.14	1.13	1.14	1.20	1.20	......	1.16
Forty-eight factories:								
Least	1.12	1.04	1.04	1.10	1.16	1.17	1.12	....
Greatest	1.15	1.18	1.17	1.18	1.28	1.22	1.17	....
Average	1.13	1.12	1.12	1.44	1.23	1.19	1.16	1.14
Average for 1893	1.14	1.12	1.12	1.14	1.21	1.19	1.16	1.14
Average for 1892 and 1893	1.14	1.14	1.13	1.13	1.21	1.21	1.15	1.15

TABULATED GENERAL SUMMARY.

Pounds of fat for one pound of solids not fat in cheese.

	Least.	Greatest.	Average.
Season of 1892	1.01	1.32	1.17
Season of 1893:			
Stone's factory	1.05	1.25	1.13
Merry's factory	1.09	1.26	1.16
Forty-eight factories	1.04	1.28	1.14
Average for 1892 and 1893	......	......	1.15

a. During the seasons of 1892 and 1893 the amount of fat for one pound of solids not fat varied from 1.01 to 1.32 pounds, and averaged 1.15 pounds.

b. In cheese made from normal milk there should always be more than one pound of fat for one pound of solids not fat.

7. GENERAL SUMMARY OF RESULTS RELATING TO THE COMPOSITION OF GREEN CHEESE MADE FROM NORMAL MILK.

1. *Pounds of water in* 100 *pounds of green cheese.*

	Least.	Greatest.	Average.
Season of 1892	33.50	38.80	36.41
Season of 1893	32.69	43.89	37.05
Seasons of 1892 and 1893	32.69	43.89	36.84

2. *Pounds of solids in* 100 *pounds of green cheese.*

	Least.	Greatest.	Average.
Season of 1892	61.20	66.50	63.59
Season of 1893	56.11	67.31	62.95
Seasons of 1892 and 1893	56.11	67.31	63.16

3. *Pounds of fat in* 100 *pounds of green cheese.*

	Least.	Greatest.	Average.
Season of 1892	31.90	36.79	34.30
Season of 1893	30.00	35.98	33.59
Seasons of 1892 and 1893	30.00	36.79	33.83

4. *Pounds of casein in* 100 *pounds of green cheese.*

	Least.	Greatest.	Average.
Season of 1892	23.18	26.10	24.30
Season of 1893	20.80	26.11	23.43
Seasons of 1892 and 1893	20.80	26.11	23.72

5. *Pounds of fat for one pound of casein in cheese.*

	Least.	Greatest.	Average.
Season of 1892	1.27	1.54	1.41
Season of 1893	1.27	1.60	1.43
Seasons of 1892 and 1893	1.27	1.60	1.42

6. *Pounds of fat for* 100 *pounds of cheese-solids.*

	Least.	Greatest.	Average.
Season of 1892	50.39	56.83	53.94
Season of 1893	51.01	56.15	53.36
Seasons of 1892 and 1893	50.39	56.83	53.56

7. *Pounds of solids not fat in* 100 *pounds of cheese-solids.*

	Least.	Greatest.	Average
Season of 1892	43.17	49.61	46.06
Season of 1893	43.85	48.99	46.64
Seasons of 1892 and 1893	43.17	49.61	46.44

8. *Pounds of fat for one pound of solids not fat in cheese.*

	Least.	Greatest.	Average.
Season of 1892	1.01	1.32	1.17
Season of 1893	1.04	1.28	1.14
Season of 1892 and 1893	1.01	1.32	1.15

9. *Tabulated monthly averages showing composition of green cheese made from normal milk.*

A. TABLE SHOWING AVERAGE COMPOSITION OF GREEN CHEESE FOR THE SEASON OF 1892.

MONTH.	Pounds of water in 100 lbs. of cheese.	Pounds of solids in 100 lbs. of cheese.	Pounds of solids not fat in 100 lbs. of cheese.	Poundsof fat in 100 lbs. of cheese.	Pounds of casein in 100 lbs. of cheese.	Pounds of sugar, ash, etc., in 100 lbs. of cheese.	Pounds of fat for one pound of casein in cheese.
May	37.10	62.90	29.30	34.00	23.60	5.30	1.45
June	36.82	63.18	29.38	33.80	25.17	4.21	1.35
July	34.90	65.10	30.91	34.19	24.66	6.25	1.39
August	35.74	64.26	29.12	35.14	24.24	4.88	1.45
September	36.29	63.71	28.08	35.63	24.26	3.82	1.47
October	37.62	62.38	29.35	33.03	23.85	5.50	1.38
Average for season	36.41	63.59	29.29	34.30	24.30	4.99	1.41

B. TABLE SHOWING AVERAGE COMPOSITION OF GREEN CHEESE FOR THE SEASON OF 1893 AT MR. STONE'S FACTORY.

MONTH.	Pounds of water in 100 lbs. of cheese.	Pounds of solids in 100 lbs. of cheese.	Pounds of solids not fat in 100 lbs. of cheese.	Pounds of fat in 100 lbs. of cheese.	Pounds of casein in 100 lbs. of cheese.	Pounds of sugar, ash, etc., in 100 lbs. of cheese.	Pounds of fat for one pound of casein in cheese.
1893.							
April	38.14	61.86	29.28	32.58	22.77	6.51	1.43
May	36.37	63.63	30.36	33.27	24.72	5.64	1.35
June	34.50	65.50	31.20	34.30	25.22	5.98	1.36
July	36.37	63.63	29.99	33.64	24.05	5.94	1.40
August....	37.48	62.52	28.30	34.22	22.38	5.92	1.53
September .	36.26	63.74	29.63	34.11	22.92	6.71	1.49
Average for season...	36.52	63.48	29.79	33.69	23.68	6.11	1.42

C. TABLE SHOWING AVERAGE COMPOSITION OF GREEN CHEESE DURING THE SEASON OF 1893 AT MR. MERRY'S FACTORY.

MONTH.	Pounds of water in 100 lbs. of cheese.	Pounds of solids in 100 lbs. of cheese.	Pounds of solids not fat in 100 lbs. of cheese.	Pounds of fat in 100 lbs. of cheese.	Pounds of casein in 100 lbs. of cheese.	Pounds of sugar, ash, etc., in 100 lbs. of cheese.	Pounds of fat for one pound of casein in cheese.
1893.							
April	37.26	62.74	29.22	33.52	23.09	6.13	1.45
May	36.84	63.16	29.58	33.58	23.65	5.93	1.42
June......	36.89	63.11	29.63	33.48	24.06	5.57	1.39
July	36.52	63.48	29.69	33.79	23.57	6.12	1.43
August....	36.46	63.54	28.86	34.68	22.59	6.27	1.53
September .	37.09	62.91	28.56	34.35	22.93	5.63	1.50
Average for season...	36.84	63.16	29.26	33.90	23.32	5.94	1.45

D. TABLE SHOWING AVERAGE COMPOSITION OF GREEN CHEESE DURING THE SEASON of 1893 AT FORTY-EIGHT FACTORIES.

MONTH.	Pounds of water in 100 lbs. of cheese.	Pounds of solids in 100 lbs. of cheese.	Pounds of solids not fat in 100,lbs. of cheese.	Pounds of fat in 100 lbs. of cheese.	Pounds of casein in 100 lbs. of cheese.	Pounds of sugar, ash, etc., in 100 lbs. of cheese.	Pounds of fat for one pound of casein in cheese.
1893.							
April	38.45	61.55	28.87	32.68	23.17	5.70	1.41
May	37.25	62.75	29.57	33.18	23.51	6.06	1.41
June	36.06	63.94	30.22	33.72	24.35	5.87	1.38
July	37.44	62.56	29.28	33.28	23.41	5.87	1.42
August....	37.54	62.46	28.05	34.41	22.41	5.64	1.53
September .	38.15	61.85	28.17	33.68	22.52	5.65	1.50
October ...	38.53	61.47	28.45	33.02	22.66	5.79	1.45
Average for season...	37.33	62.67	29.26	33.41	23.39	5.87	1.43

E. TABLE SHOWING AVERAGE COMPOSITION OF GREEN CHEESE DURING THE SEASON OF 1893 AT ALL FACTORIES.

MONTH.	Pounds of water in 100 lbs. of cheese.	Pounds of solids in 100 lbs. of cheese.	Pounds of solids not fat in 100 lbs. of cheese.	Pounds of fat in 100 lbs. of cheese.	Pounds of casein in 100 lbs. of cheese.	Pounds of sugar, ash, etc., in 100 lbs. of cheese.	Pounds of fat for one pound of casein in cheese.
1893.							
April	38.00	62.00	29.06	32.94	23.02	6.04	1.43
May	37.12	62.88	29.66	33.22	23.62	6.04	1.41
June	35.92	64.08	30.30	33.78	24.48	5.82	1.38
July	36.93	63.07	29.54	33.53	23.61	5.93	1.42
August....	37.16	62.84	28.40	34.44	22.44	5.96	1.53
September .	37.15	62.85	28.75	34.10	22.83	5.92	1.50
October ...	38.62	64.38	28.42	32.96	22.63	5.79	1.45
Average for season...	37.05	62.95	29.86	33.59	23.43	5.93	1.43

F. Table Showing Average Composition of Green Cheese Made from Normal Factory Milk During the Seasons of 1892 and 1893.

MONTH.	Pounds of water in 100 lbs. of cheese.	Pounds of solids in 100 lbs. of cheese.	Pounds of solids not fat in 100 lbs. of cheese.	Pounds of fat in 100 lbs. of cheese.	Pounds of casein in 100 lbs. of cheese.	Pounds of sugar, ash, etc , in 100 lbs. of cheese.	Pounds of fat for one pound of casein in cheese.
1892–1893.							
April	38.00	62.00	29.06	32.94	23.02	6.04	1.43
May	37.11	62.89	29.41	33.48	23.61	5.80	1.42
June	36.22	63.78	29.99	33.79	24.71	5.28	1.38
July	36.25	63.75	30.00	33.75	23.96	6.04	1.41
August....	36.69	63.31	28.64	34.67	23.04	5.60	1.50
September .	36.86	63.14	28.54	34.60	23.30	5.24	1.48
October ...	38.29	61.71	28.73	32.98	23.04	5.69	1.43
Avg for two seasons ..	36.84	63.16	29.33	33.83	23.72	5.61	1.42

XV. LOSS OF MILK-CONSTITUENTS IN CHEESE-MAKING.

Under this general head the following topics will be considered:

1. Amount of solids in milk lost and recovered in cheese-making.

2. Amount of fat in milk lost and recovered in cheese-making.

3. Amount of casein and albumen lost and recovered in cheese-making.

4. General summary.

1. Amount of Solids in Milk Lost and Recovered in Cheese-Making.

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES OF MILK-SOLIDS LOST AND RECOVERD IN CHEESE-MAKING DURING THE SEASON.

1893.	Pounds of fat in 100 lbs. of milk.	Pounds of milk-solids in 100 lbs. of milk.	Pounds of milk-solids lost in whey for 100 lbs. of milk.	Pounds of milk-solids recovered in cheese for 100 lbs. of milk.	Per cent of milk-solids lost in whey.	Per cent of milk-solids recovered in cheese.	Pounds of milk-solids recovered in cheese for one pound of solids lost in whey.
April.							
Second week	3.43	12.00	6.19	5.81	51.58	48.42	0.94
Third week	3.47	12.06	6.25	5.81	51.82	48.18	0.93
Fourth week	3.40	11.89	6.15	5.74	51.72	48.28	0.93
Average for April	3.43	11.98	6.19	5.79	51.67	48.33	0.93
May.							
First week	3.46	12.09	6.23	5.86	51.53	48.47	0.94
Second week	3.46	12.16	6.30	5.86	51.81	48.19	0.93
Third week	3.60	12.39	6.30	6.09	50.85	49.15	0.97
Fourth week	3.81	12.89	6.35	6.54	49.26	50.60	1.03
Average for May	3.67	12.56	6.31	6.25	50.24	49.76	0.99
June.							
First week	3.67	12.74	6.32	6.42	49.61	50.39	1.02
Second week	3.53	12.56	6.36	6.20	50.64	49.36	0.98
Third week	3.73	12.78	6.34	6.44	49.61	50.39	1.02
Fourth week	3.63	12.62	6.25	6.37	49.52	50.48	1.02
Average for June	3.66	12.69	6.31	6.38	49.72	50.28	1.01

July.							
First week	3.50	12.47	6.35	6.12	50.92	49.08	0.96
Second week	3.60	12.48	6.24	6.24	50.00	50.00	1.00
Third week	3.64	12.51	6.29	6.22	50.28	49.72	0.99
Fourth week	3.65	12.42	6.26	6.16	50.40	49.60	1.02
Average for July	3.62	12.48	6.28	6.20	50.32	49.68	0.99
August.							
First week	3.73	12.49	6.20	6.29	49.64	50.36	1.01
Second week	3.73	12.50	6.32	6.18	50.56	49.44	0.98
Third week	3.79	12.47	6.16	6.31	49.40	50.60	1.02
Fourth week	3.99	12.80	6.22	6.58	48.59	51.41	1.06
Average for August	3.87	12.63	6.21	6.42	49.17	50.83	1.03
September.							
First week	4.03	12.89	6.20	6.69	48.10	51.90	1.08
Second week	4.00	12.89	6.24	6.65	48.41	51.49	1.07
Third week	4.00	12.90	6.24	6.66	48.37	51.63	1.07
Fourth week	4.20	13.33	6.28	7.05	47.10	52.90	1.12
Average for September	4.06	13.00	6.23	6.77	47.92	52.08	1.09
October.							
First week	4.20	13.46	6.34	7.12	47.10	52.90	1.12
Second week	4.25	13.57	6.43	7.14	47.40	52.60	1.11
Third week	4.35	13.57	6.21	7.36	45.76	54.24	1.18
Fourth week	4.25	13.51	6.20	7.31	45.90	54.10	1.18
Average for October	4.28	13.53	6.26	7.27	46.27	53.73	1.16

TABLE SHOWING POUNDS OF MILK-SOLIDS LOST IN WHEY FOR 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	.....	6.05	6.21	6.09	6.09	5.81	5.87	....
Greatest	......	6.83	6.40	6.48	6.36	6.28	6.09	....
Average	......	6.49	6.31	6.23	6.22	6.02	6.03	6.21
1893.								
Stone's factory:								
Least	6.25	6.34	6.25	6.20	6.10	6.26	......	....
Greatest	6.30	6.43	6.39	6.33	6.32	6.32	......	....
Average	6.27	6.37	6.32	6.28	6.18	6.29	......	6.28
Merry's factory:								
Least	6.13	6.26	6.27	6.20	6.16	6.09	......	....
Greatest	6.19	6.44	6.35	6.38	6.32	6.24	......	....
Average	6.16	6.34	6.30	6.28	6.23	6.18	......	6.25
Forty-eight factories:								
Least	6.11	6.16	6.20	6.20	6.12	6.18	6.16	....
Greatest	6.20	6.45	6.46	6.37	6.30	6.40	6.43	....
Average	6.17	6.29	6.32	6.29	6.22	6.29	6.26	6.28
Average for 1893	6.19	6.31	6.31	6.28	6.21	6.23	6.26	6.27
Average for 1892 and 1893	6.19	6.35	6.31	6.26	6.21	6.11	6.14	6.25

Tabulated General Summary.

Pounds of milk-solids lost in whey for 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	5.81	6.83	6.21
Season of 1893:			
Stone's factory	6.10	6.43	6.28
Merry's factory	6.09	6.44	6.25
Forty-eight factories	6.11	6.49	6.28
Average for 1892 and 1893	......	......	6.25

a. Taking the seasons of 1892 and 1893, the amount of milk-solids lost in the whey for 100 pounds of milk varied from 5.81 to 6.83 pounds and averaged 6.25 pounds. It will be noticed that the variations in 1893 were within much narrower limits than in 1892.

b. Taking the monthly averages of the results we see quite close uniformity in the results, though there was a tendency to smaller loss of milk-solids as the season advanced.

TABLE SHOWING PER CENT. OF MILK-SOLIDS LOST IN WHEY.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	52.72	50.04	48.84	49.00	47.62	43.59	....
Greatest	......	54.73	50.60	50.90	50.04	49.22	45.09	....
Average	......	54.45	50.36	49.45	49.01	48.00	44.40	49.13
1893.								
Stone's factory:								
Least	51.51	49.00	48.84	49.80	48.68	48.12	......	....
Greatest	52.17	51.71	50.16	50.28	50.56	48.80	......	....
Average	51.82	50.56	49.65	50.08	49.40	48.46	......	49.92
Merry's factory:								
Least	51.38	49.84	49.88	50.04	47.97	46.54	......	....
Greatest	51.71	53.40	50.97	51.70	50.56	48.79	......	....
Average	51.50	51.00	50.40	50.77	49.48	47.90	......	50.16
Forty-eight factories:								
Least	51.37	48.05	48.60	48.36	47.60	47.58	45.34	....
Greatest	52.22	52.95	52.13	51.87	49.65	47.76	47.38	....
Average	51.80	50.00	49.60	50.32	48.82	47.65	46.27	49.37
Average for 1893	51.67	50.24	49.72	50.32	49.17	47.92	46.27	49.68
Average for 1892 and 1893	51.67	51.09	49.92	50.00	49.09	47.51	45.38	49.48

TABULATED GENERAL SUMMARY.

Per cent. of milk-solids lost in whey.

	Least.	Greatest.	Average.
Season of 1892	43.59	54.73	49.13
Season of 1893:			
Stone's factory	48.12	52.17	49.92
Merry's factory	46.54	53.40	50.16
Forty-eight factories	45.34	52.95	49.37
Average for 1892 and 1893	......	......	49.48

a. During the seasons of 1892 and 1893 the per cent. of solids in milk that was lost in the whey varied from 43.59 to 54.73 per cent. and averaged 49.48 per cent.

b. The proportion of milk solids lost in the whey decreased quite regularly from month to month as the season advanced. This is what we should expect since the cheese-making solids of the milk (fat and casein) increased in quantity from month to month, while the whey solids (albumen, sugar and ash) remained quite uniform, increasing only a little as compared with the fat and casein.

c. The proportion of milk solids lost in the whey averages greater in the results secured at the factories of Mr. Merry and Mr. Stone than at the other factories, because no results in cheese making were secured from these two factories in October (as they were making skim-milk cheese), and, as the loss of milk solids was smallest in October, the October results, if secured, would have reduced the season's averages considerably.

TABLE SHOWING POUNDS OF MILK-SOLIDS RECOVERED IN CHEESE FOR 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	5.31	5.96	6.28	6.21	6.08	7.18	....
Greatest	......	5.79	6.41	6.68	6.77	6.56	7.58	....
Average	......	5.43	6.22	6.37	6.47	6.53	7.55	6.43
1893.								
Stone's factory:								
Least	5.73	5.93	6.32	6.20	6.18	6.63	......	....
Greatest	5.93	6.60	6.61	6.35	6.44	6.75	......	....
Average	5.83	6.23	6.41	6.26	6.33	6.69	......	6.30
Merry's factory:								
Least	5.78	5.55	6.06	5.96	6.15	6.54	......	....
Greatest	5.81	6.60	6.32	6.19	6.68	7.09	.....	....
Average	5.80	6.09	6.20	6.09	6.36	6.72	......	6.21
Forty-eight factories:								
Least	5.59	5.59	5.96	5.91	6.31	6.81	7.12	....
Greatest	5.87	6.81	6.63	6.62	6.78	7.00	7.50	....
Average	5.74	6.29	6.42	6.21	6.52	6.91	7.27	6.44
Average for 1893	5.79	6.25	6.38	6.20	6.42	6.77	7.27	6.35
Average for 1892 and 1893	5.79	6.08	6.33	6.26	6.44	6.75	7.39	6.38

TABULATED GENERAL SUMMARY.

Pounds of milk-solids recovered in cheese for 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	5.31	7.58	6.43
Season of 1893:			
Stone's factory	5.73	6.75	6.30
Merry's factory	5.55	7.09	6.21
Forty-eight factories	5.59	7.50	6.44
Average for 1893	......	......	6.38

a. During the seasons of 1892 and 1893 the amount of milk solids recovered in cheese for 100 pounds of milk varied from 5.31 to 7.58 pounds and averaged 6.38 pounds.

b. There was a steady increase, from month to month, of the amount of milk solids recovered in cheese as the season advanced. Since the increase of solids in the milk during the season is due mainly to an increase of fat and casein, which are the chief cheese-producing constituents of the milk, this increase of solids retained in the cheese was a necessary consequence of the natural change in the composition of the milk as a result of the advance of lactation.

TABLE SHOWING PER CENT. OF MILK-SOLIDS RECOVERED IN CHEESE.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	45.27	49.40	50.10	46.96	50.78	54.91	....
Greatest	......	47.28	49.96	51.16	53.00	52.38	56.43	....
Average	......	45.55	49.64	50.55	50.99	52.00	55.60	50.87
1893.								
Stone's factory:								
Least	47.87	48.29	49.84	49.72	49.44	51.20	......	....
Greatest	48.49	51.00	51.16	50.12	51.32	51.88	......	....
Average	48.18	49.44	50.35	49.92	50.60	51.54	......	50.08
Merry's factory:								
Least	48.29	46.60	49.03	48.30	49.44	51.21	......	....
Greatest	48.62	51.16	50.12	49.96	52.03	53.46	......	....
Average	48.50	49.00	49.60	49.23	50.52	52.10	......	49.84
Forty-eight factories:								
Least	47.78	47.05	47.87	48.13	50.35	52.24	52.62	....
Greatest	48.63	51.95	51.40	51.64	52.40	52.42	54.66	....
Average.	48.20	50.00	50.40	49.68	51.18	52.35	53.73	50.63
Average for 1893	48.33	49.76	50.28	49.68	50.83	52.08	53.73	50.32
Average for 1892 and 1893	48.33	48.91	50,08	50.00	50.91	52.49	54.62	50.52

TABULATED GENERAL SUMMARY.

Per cent. of milk-solids recovered in cheese.

	Least.	Greatest.	Average.
Season of 1892	45.27	56.43	50.87
Season of 1893:			
Stone's factory	47.87	51.88	50.08
Merry's factory	46.60	53.46	49.84
Forty-eight factories	47.05	54.66	50.63
Average for 1892 and 1893	......	......	50.52

a. During the seasons of 1892 and 1893 the per cent. of solids in milk recovered in cheese varied from 45.27 to 56.43 per cent. and averaged 50.52 per cent.

b. Owing to natural changes taking place in the composition of the milk as the season advanced, the per cent. of milk-solids retained in cheese increased from month to month.

c. As stated above, the proportion of milk-solids recovered in cheese would have averaged a little greater, if work at all the factories had been continued through October.

II. Amount of Fat in Milk Lost and Recovered in Cheese-Making.

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES OF FAT LOST AND RECOVERED IN CHEESE-MAKING DURING THE SEASON.

1893.	Pounds of fat in 100 lbs. of milk.	Pounds of fat lost in whey for 100 lbs. of milk.	Pounds of fat recovered in cheese for 100 lbs. of milk.	Per cent. of fat in milk lost in whey.	Per cent. of fat in milk recovered in cheese.
April.					
Second week	3.43	0.30	3.13	8.74	92.26
Third week	3.47	0.40	3.07	11.53	88.47
Fourth week	3.40	0.36	3.04	10.59	89.41
Average for April	3.43	0.36	3.07	10.50	89.50
May.					
First week	3.46	0.36	3.10	10.40	89.60
Second week	3.46	0.34	3.12	9.83	90.17
Third week	3.60	0.38	3.22	10.56	89.44
Fourth week	3.81	0.37	3.44	9.71	90.29
Average for May	3.67	0.36	3.31	9.81	90.19
June.					
First week	3.67	0.31	3.36	8.45	91.55
Second week	3.53	0.33	3.20	9.35	90.65
Third week	3.73	0.31	3.42	8.31	91.69
Fourth week	3.63	0.24	3.39	6.61	93.39
Average for June	3.66	0.29	3.37	7.92	92.08
July.					
First week	3.50	0.28	3.22	8.00	92.00
Second week	3.60	0.32	3.38	8.89	91.11
Third week	3.64	0.33	3.31	9.07	90.93
Fourth week	3.65	0.34	3.31	9.32	90.68
Average for July	3.62	0.32	3.30	8.84	91.16
August.					
First week	3.73	0.31	3.42	8.31	91.69
Second week	3.73	0.36	3.37	9.65	90.35
Third week	3.79	0.35	3.44	9.23	90.77
Fourth week	3.99	0.36	3.63	9.02	90.98
Average for August.	3.87	0.35	3.52	9.04	90.96

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES OF FAT LOST AND RECOVERED, ETC.—(*Concluded*).

1893.	Pounds of fat in 100 lbs. of milk.	Pounds of fat lost in whey for 100 lbs. of milk.	Pounds of fat recovered in cheese for 100 lbs. of milk.	Per cent. of fat in milk lost in whey.	Per cent. of fat in milk recovered in cheese.
September.					
First week	4.03	0.41	3.62	10.17	89.83
Second week	4.00	0.38	3.62	9.50	90.50
Third week	4.00	0.32	3.68	8.00	92.00
Fourth week	4.20	0.41	3.79	9.76	90.24
Average for Sept.	4.06	0.39	3.67	9.60	90.40
October.					
First week	4.20	0.36	3.84	8.57	91.42
Second week	4.25	0.44	3.81	10.35	89.65
Third week	4.35	0.37	3.98	8.51	91.49
Fourth week	4.25	0.34	3.91	8.00	92.00
Average for Oct	4.27	0.36	3.91	8.43	91.57

TABLE SHOWING POUNDS OF MILK-FAT LOST IN WHEY FOR 100 POUNDS OF MILK.

	April.	May.	June.	July.	August.	September.	October.	Average for season.
1892.								
Least	.....	0.24	0.21	0.21	0.26	0.30	0.26	.....
Greatest	.....	0.33	0.34	0.45	0.37	0.41	0.35	.....
Average	.....	0.29	0.27	0.31	0.32	0.35	0.31	0.31
1893.								
Stone's factory:								
Least	0.39	0.37	0.26	0.31	0.31	0.38	.....	.....
Greatest	0.42	0.50	0.36	0.36	0.38	0.46	.....	.....
Average	0.40	0.45	0.32	0.34	0.34	0.42	.....	0.37
Merry's factory:								
Least	0.32	0.27	0.24	0.26	0.31	0.32	.....	.....
Greatest	0.38	0.35	0.34	0.36	0.38	0.41	.....	.....
Average	0.35	0.31	0.28	0.31	0.35	0.37	.....	0.33
48 factories:								
Least	0.29	0.30	0.22	0.28	0.31	0.36	0.31	.....
Greatest	0.40	0.45	0.36	0.38	0.40	0.42	0.44	.....
Average	0.34	0.36	0.29	0.33	0.35	0.39	0.36	0.34
Average for 1893	0.36	0.36	0.29	0.32	0.35	0.39	0.36	0.34
Average for 1892 and 1893	0.36	0.35	0.28	0.32	0.34	0.37	0.33	0.33

Tabulated general summary.

	POUNDS OF FAT LOST IN WHEY FOR 100 POUNDS OF MILK.		
	Least.	Greatest.	Average.
Season of 1892	0.21	0.45	0.31
Season of 1893:			
Stone's factory	0.26	0.50	0.37
Merry's factory	0.24	0.41	0.33
Forty-eight factories	0.22	0.45	0.34
Average for 1892 and 1893	......	......	0.33

a. The amount of fat lost in whey for 100 pounds of milk varied from 0.21 to 0.5 pounds and averaged 0.33 pounds during the season of 1892 and 1893.

b. The average amount of fat lost was smallest in June and July and greatest during the early and late months of the season.

TABLE SHOWING PER CENT. OF FAT IN MILK LOST IN WHEY.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	7.87	6.09	5.68	6.93	7.69	6.12	....
Greatest	......	10.00	9.66	12.86	9.44	10.38	8.67	....
Average	......	9.06	7.54	8.54	8.50	9.19	7.50	8.40
1893.								
Stone's factory:								
Least	11.47	9.74	7.22	8.73	8.16	9.50	......	....
Greatest	11.83	13.51	10.00	9.86	10.13	11.50	......	....
Average	11.53	12.16	8.70	9.32	8.92	10.50	......	9.97
Merry's factory:								
Least	9.28	7.57	6.67	7.54	8.49	8.00	......	....
Greatest	11.02	10.61	9.19	10.00	9.47	10.25	......	....
Average	10.14	8.73	7.82	8.73	9.16	9.14	......	9.00
Forty-eight factories:								
Least	8.53	8.11	5.80	7.78	7.56	8.78	7.38	....
Greatest	11.45	11.25	10.59	10.27	10.53	10.00	10.35	....
Average	10.03	9.76	7.88	9.09	8.89	9.40	8.43	9.02
Average for 1893	10.50	9.81	7.92	8.84	9.04	9.60	8.43	9.12
Average for 1892 and 1893	10.50	9.78	7.71	8.82	8.85	9.44	7.86	8.87

TABULATED GENERAL SUMMARY.

Per cent. of fat in milk lost in whey.

	Least.	Greatest.	Average.
Season of 1892	5.68	12.86	8.40
Season of 1893:			
Stone's factory	7.22	13.51	9.97
Merry's factory	6.67	11.02	9.00
Forty-eight factories	5.80	11.43	9.02
Average for 1892 and 1893	......	......	8.87

a. The per cent. of fat in milk lost in whey during the seasons of 1892 and 1893 varied from 5.68 to 13.51 per cent., and averaged 8.87 per cent. of the fat in the milk.

b. Taking the monthly averages, we see that the smallest proportion of fat lost was in June, and the next smallest loss was in October, when the milk contained most fat; while the largest loss occurred in April or May, when the amount of fat in milk was least.

c. The excessive loss of fat at Mr. Stone's factory was probably due to the use of a rather high temperature in heating the curd, which was proved by our work in 1892 to cause loss of fat.

d. The facts all go to show that the proportion of fat lost in cheese-making is quite independent of the amount of fat in the milk. The variations that occur in loss of fat are due either to the condition of the milk or to some special conditions employed in manufacture.

TABLE SHOWING POUNDS OF FAT IN MILK RECOVERED IN CHEESE FOR 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	2.77	3.24	3.05	3.18	3.19	3.67	....
Greatest	......	3.07	3.48	3.49	3.71	3.60	4.03	....
Average	......	2.91	3.31	3.32	3.45	3.46	3.83	3.38
1893.								
Stone's factory:								
Least	3.01	3.13	3.24	3.24	3.37	3.54	......	....
Greatest	3.13	3.43	3.49	3.37	3.52	3.62	......	....
Average	3.07	3.25	3.36	3.31	3.47	3.58	......	3.34
Merry's factory:								
Least	3.07	2.95	3.20	3.19	3.34	3.59	......	....
Greatest	3.13	3.45	3.36	3.27	3.72	3.81	......	....
Average	3.10	3.24	3.30	3.24	3.47	3.68	......	3.34
Forty-eight factories:								
Least	2.99	2.94	3.04	3.17	3.40	3.74	3.81	....
Greatest	3.11	3.67	3.49	3.48	3.79	3.78	4.05	....
Average	3.05	3.33	3.39	3.30	3.59	3.76	3.91	3.43
Average for 1893	3.07	3.31	3.37	3.30	3.52	3.67	3.91	3.39
Average for 1892 and 1893	3.07	3.22	3.35	3.31	3.50	3.55	3.87	3.39

TABULATED GENERAL SUMMARY.

Pounds of fat in 100 *pounds of milk recovered in cheese.*

	Least.	Greatest.	Average.
Season of 1982	2.77	4.03	3.38
Season of 1893:			
Stone's factory	3.01	3.62	3.34
Merry's factory	2.95	3.81	3.34
Forty-eight factories	2.94	4.05	3.43
Average for 1892 and 1893	......	......	3.39

a. The amount of fat recovered in cheese for 100 pounds of milk varied from 2.77 to 4.05 pounds and averaged 3.39 pounds during the seasons of 1892 and 1893.

b. The amount of fat recovered in cheese increased from month to month, because the amount of fat in milk increased.

TABLE SHOWING PER CENT. OF FAT IN MILK RECOVERED IN CHEESE.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	90.00	90.34	87.14	90.56	89.62	91.33	....
Greatest	......	92.13	93.91	94.32	93.17	92.31	93.88	....
Average	.. ...	90.94	92.46	91.46	91.50	90.81	92.50	91.60
1893.								
Stone's factory:								
Least	88.17	86.49	90.00	90.14	89.87	88.50	......	....
Greatest	88.53	90.26	92.78	91.27	91.84	90.50	......	....
Average	88.47	87.84	91.30	90.68	91.08	89.50	......	90.03
Merry's factory:								
Least	88.98	89.39	90.81	90.00	90.53	89.75	......	....
Greatest	90.72	92.43	93.33	92.46	91.51	92.00	......	....
Average	89.86	91.27	92.18	91.27	90.84	90.86	......	91.00
Forty-eight factories:								
Least	88.57	88.75	89.41	89.73	89.47	90.00	89.65	....
Greatest	91.47	91.89	94.20	92.22	92.44	91.22	92.62	....
Average	89.97	90.24	92.12	90.91	91.11	90.60	91.57	90.98
Average for 1893	89.50	90.19	92.08	91.16	90.96	90.40	91.57	90.88
Average for 1892 and 1893	89.50	90.22	92.29	91.18	91.15	90.56	92.14	91.13

TABULATED GENERAL SUMMARY.

Per cent. of fat in milk recovered in cheese.

	Least.	Greatest.	Average.
Season of 1892	87.14	94.32	91.60
Season of 1893:			
Stone's factory	86.49	92.78	90.03
Merry's factory	88.98	93.33	91.00
Forty-eight factories	88.57	94.20	90.98
Average for 1892 and 1893	......	......	91.13

a. The proportion of milk fat recovered in cheese varied from 86.49 to 94.32 per cent., and averaged 91.13 per cent. of the fat in the milk during the seasons of 1892 and 1893.

b. The proportion of fat recovered in cheese was least in April and greatest in June, and quite uniform for the other months.

III. Amount of Casein and Albumen in Milk Lost and Recovered in Cheese-Making.

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES OF CASEIN AND ALBUMEN LOST AND RECOVERED IN CHEESE-MAKING DURING THE SEASON.

1893.	Pounds of casein and albumen in 100 lbs of milk.	Pounds of casein and albumen lost in whey for 100 lbs of milk.	Pounds of casein and albumen recovered in cheese for 100 lbs of milk.	Per cent. of casein and albumen in milk lost in whey.	Per cent. of casein and albumen in milk recovered in cheese.
April.					
Second week	2.87	0.69	2.18	24.06	75.94
Third week	2.80	0.67	2.13	23.93	76.07
Fourth week	2.78	0.64	2.14	23.02	76.98
Average for April	2.81	0.66	2.15	23.49	76.51
May.					
First week	2.81	0.67	2.14	23.84	76.16
Second week	2.90	0.73	2.17	25.17	74.83
Third week	3.03	0.73	2.30	24.09	75.91
Fourth week	3.31	0.82	2.49	24.77	75.23
Average for May	3.11	0.76	2.35	24.44	75.56
June.					
First week	3.26	0.80	2.46	24.54	75.46
Second week	3.24	0.80	2.44	24.69	75.31
Third week	3.24	0.81	2.43	25.00	75.00
Fourth week	3.20	0.78	2.42	24.37	75.63
Average for June	3.23	0.80	2.43	24.77	75.23
July.					
First week	3.10	0.75	2.35	24.20	75.80
Second week	3.08	0.73	2.35	23.70	76.30
Third week	3.09	0.77	2.32	24.92	75.08
Fourth week	3.99	0.71	2.28	23.75	76.25
Average for July	3.06	0.75	2.31	24.51	75.49
August.					
First week	2.92	0.65	2.27	22.26	77.74
Second week	2.90	0.69	2.22	23.80	76.20
Third week	2.96	0.72	2.24	24.32	75.68
Fourth week	3.08	0.73	2.35	23.70	76.30
Average for August	3.01	0.71	2.30	23.59	76.41

TABLE SHOWING WEEKLY AND MONTHLY AVERAGES, ETC.—(*Concluded.*)

1893.	Pounds of casein and albumen in 100 lbs. of milk.	Pounds of casein and albumen lost in whey for 100 lbs. of milk.	Pounds of casein and albumen recovered in cheese for 100 lbs. of milk.	Per cent. of casein and albumen in milk lost in whey.	Per cent. of casein and albumen in milk recovered in cheese.
September.					
First week	3.16	0.77	2.39	24.37	75.63
Second week.........	3.17	0.75	2.42	23.66	76.34
Third week..........	3.23	0.79	2.44	24.46	75.54
Fourth week.........	3.43	0.82	2.61	23.91	76.09
Average for Sept...	3.24	0.78	2.46	24.07	75.93
October.					
First week	3.47	0.88	2.59	25.35	74.65
Second week.........	3.50	0.88	2.62	25.14	74.86
Third week..........	3.55	0.85	2.70	23.94	76.06
Fourth week.........	3.55	0.83	2.72	23.38	76.62
Average for Oct ...	3.53	0.85	2.68	24.08	75.92

TABLE SHOWING POUNDS OF CASEIN AND ALBUMEN LOST IN WHEY FOR 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	0.61	0.76	0.70	0.72	0.70	0.79	....
Greatest	......	0.68	0.80	0.77	0.75	0.77	0.94	....
Average	......	0.64	0.78	0.73	0.73	0.74	0.88	0.75
1893.								
Stone's factory:								
Least	0.66	0.74	0.76	0.68	0.58	0.76	......	....
Greatest	0.68	0.86	0.82	0.77	0.73	0.77	......	....
Average	0.67	0.81	0.80	0.72	0.66	0.77	......	0.74
Merry's factory:								
Least	0.64	0.69	0.76	0.72	0.70	0.75	......	....
Greatest	0.72	0.82	0.78	0.74	0.77	0.81	......	....
Average	0.68	0.75	0.77	0.73	0.73	0.77	......	0.74
Forty-eight factories:								
Least	0.60	0.64	0.77	0.72	0.68	0.77	0.82	....
Greatest	0.66	0.83	0.83	0.79	0.81	0.82	0.88	....
Average	0.64	0.76	0.80	0.76	0.73	0.79	0.85	0.77
Average for 1893	0.66	0.76	0.80	0.75	0.71	0.78	0.85	0.76
Average for 1892 and 1893	0.66	0.74	0.79	0.74	0.72	0.76	0.87	0.76

TABULATED GENERAL SUMMARY.

Pounds of casein and albumen lost in whey for 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	0.61	0.94	0.75
Season of 1893:			
Stone's factory	0.58	0.86	0.74
Merry's factory	0.64	0.82	0.74
Forty-eight factories	0.60	0.88	0.77
Average for 1892 and 1893	......	......	0.76

a. During the seasons of 1892 and 1893 the amount of casein and albumen lost in whey for 100 pounds of milk varied from 0.58 to 0.94 pounds and averaged 0.76 pounds.

b. The smallest average losses of casein and albumen in whey occurred in April, and the amount of loss increased during May and June and then decreased or remained fairly uniform until October, when it was largest.

TABLE SHOWING PER CENT. OF CASEIN AND ALBUMEN IN MILK LOST IN WHEY.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	23.46	23.31	22.90	23.38	22.50	22.07	....
Greatest	......	24.50	24.69	24.84	24.59	24.67	25.00	....
Average	......	24.10	24.00	23.70	24.00	23.72	24.00	23.96
1893.								
Stone's factory:								
Least	23.49	24.18	23.53	22.37	20.00	23.68	......	....
Greatest	24.15	26.30	25.00	24.21	24.25	24.60	......	....
Average	23.76	25.15	24.46	23.38	22.53	24.29	......	23.95
Merry's factory:								
Least	23.10	23.77	24.30	24.17	23.60	23.62	......	....
Greatest	24.91	26.07	24.76	25.00	25.84	24.46	......	....
Average	24.20	24.75	24.52	24.42	24.41	24.84	......	24.42
Forty-eight factories:								
Least	21.82	22.86	24.24	23.22	23.05	23.98	23.10	....
Greatest	23.47	25.46	25.55	26.24	25.71	24.06	25.36	....
Average	22.86	24.44	24.62	24.60	23.78	23.87	24.08	24.29
Average for 1893	23.49	24.44	24.77	24.51	23.59	24.07	24.08	24.28
Average for 1892 and 1893	23.49	24.50	24.46	24.18	23.84	23.98	24.17	24.28

TABULATED GENERAL SUMMARY.

Per cent. of casein and albumen in milk lost in whey.

	Least.	Greatest.	Average.
Season of 1892	22.07	25.00	23.96
Season of 1893:			
Stone's factory	20.00	26.30	23.95
Merry's factory	23.10	26.07	24.42
Forty-eight factories	21.82	26.24	24.29
Average for 1892 and 1893	......	......	24.28

a. During the seasons of 1892 and 1893, the per cent. of casein and albumen in milk lost in whey varied from 20 to 26.3 per cent. and averaged 24.28 per cent. of the casein and albumen in the milk.

b. The proportion of casein and albumen lost in whey was least in April and increased in May and June, after which it decreased somewhat.

c. The larger proportion of casein and albumen lost at Mr. Merry's factory was due to the fact that the milk contained a larger proportion of albumen for its casein than did the other milks.

d. A careful study of our results shows that the proportion of casein and albumen lost in cheese-making is remarkably uniform and that variation of conditions of manufacture has little influence upon this loss, the chief determining cause of loss being the amount of albumen in the milk, most of which goes into the whey.

Table Showing Pounds of Casein and Albumen Recovered in Cheese for 100 Pounds of Milk.

1892.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average for season.
Least	.....	1.90	2.41	2.31	2.27	2.32	2.71	......
Greatest	.....	2.10	2.51	2.39	2.36	2.46	2.82	......
Average	.....	2.01	2.47	2.35	2.31	2.38	2.78	2.38
1893. Stone's factory:								
Least	2.14	2.32	2.43	2.28	2.22	2.36	.....	......
Greatest	2.15	2.52	2.49	2.43	2.32	2.45	.....	......
Average	2.15	2.41	2.47	2.36	2.27	2.40	.....	2.35
Merry's factory:								
Least	2.10	2.07	2.31	2.22	2.19	2.37	.....	......
Greatest	2.17	2.47	2.43	2.29	2.34	2.62	.....	......
Average	2.13	2.28	2.37	2.26	2.26	2.46	.....	2.29
48 factories:								
Least	2.12	2.12	2.31	2.21	2.27	2.43	2.59	......
Greatest	2.21	2.59	2.52	2.48	2.37	2.60	2.76	......
Average	2.16	2.35	2.45	2.33	2.34	2.52	2.68	2.40
Average for 1893	2.15	2.35	2.43	2.31	2.30	2.46	2.68	2.37
Average for 1892–3	2.15	2.28	2.44	2.32	2.30	2.41	2.73	2.37

TABULATED GENERAL SUMMARY.

Pounds of casein and albumen recovered in cheese for 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	1.90	2.82	2.38
Season of 1893:			
Stone's factory	2.14	2.52	2.35
Merry's factory	2.07	2.62	2.29
Forty-eight factories	2.12	2.76	2.40
Average for 1892 and 1893	......	......	2.37

a. During the seasons of 1892 and 1893, the amount of casein and albumen recovered in cheese for 100 pounds of milk varied from 1.9 to 2.82 pounds and averaged 2.37 pounds.

b. The amount of casein and albumen recovered in cheese is, for the most part, quite independent of the conditions of manufacture. The amount recovered quite closely follows the amount of casein present in the milk.

TABLE SHOWING PER CENT. OF CASEIN AND ALBUMEN IN MILK RECOVERED IN CHEESE.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	75.50	75.31	75.16	75.41	75.33	75.00	....
Greatest	......	76.54	76.69	77.10	76.62	77.50	77.93	....
Average	......	75.90	76.00	76.30	76.00	76.28	76.00	76.04
1893.								
Stone's factory:								
Least	75.89	73.70	75.00	75.79	75.75	75.40	......	....
Greatest	76.51	75.82	76.47	77.63	80.00	76.32	......	....
Average	76.24	74.85	75.54	76.62	77.47	75.71	......	76.05
Merry's factory:								
Least	75.09	73.93	75.24	75.00	74.16	75.54	......	....
Greatest	76.90	76.23	75.70	75.83	76.40	76.38	......	....
Average	75.80	75.25	75.48	75.58	75.59	76.16	......	75.58
Forty-eight factories:								
Least	76.53	74.54	74.45	73.76	74.29	75.94	74.64	....
Greatest	78.18	77.14	75.76	76.78	76.95	76.02	76.90	....
Average	77.14	75.56	75.38	75.40	76.22	76.13	75.92	75.71
Average for 1893	76.51	75.56	75.23	75.49	76.41	75.93	75.92	75.72
Average for 1892 and 1893	76.51	75.50	75.54	75.82	76.16	76.02	75.83	75.72

TABULATED GENERAL SUMMARY.

Per cent. of casein and albumen recovered in cheese.

	Least.	Greatest.	Average.
Season of 1892	75.00	77.93	76.04
Season of 1893:			
Stone's factory	73.70	80.00	76.05
Merry's factory	73.93	76.90	75.58
Forty-eight factories	73.76	78.18	75.71
Average for 1892 and 1893	......	......	75.72

a. During the season of 1892 and 1893, the proportion of casein and albumen in milk recovered in cheese varied from 73.7 to eighty per cent and averaged 75.72 per cent. of the casein and albumen in the milk.

b. The proportion of casein and albumen recovered in cheese was more dependent upon the proportion of casein, relative to albumen, in the milk than upon the conditions of manufacture.

TABLE SHOWING RELATION OF CASEIN IN MILK TO CASEIN AND ALBUMEN IN CHEESE.

DATE — 1893.	Pounds of casein in 100 lbs. of milk.	Pounds of casein and albumen in cheese made from 100 lbs. of milk.	Amount of casein in milk in excess of casein and albumen in cheese.
April.			
Second week	3.34	2.18	0.16
Third week	2.30	2.13	0.17
Fourth week	2.24	2.14	0.10
May.			
First week,	2.23	2.14	0.09
Second week	2.27	2.17	0.10
Third week	2.34	2.30	0.04
Fourth week	2.56	2.49	0.07
June.			
First week	2.48	2.46	0.02
Second week	2.49	2.44	0.05
Third week	2.48	2.43	0.05
Fourth week	2.47	2.42	0.05
July.			
First week	2.41	2.35	0.06
Second week	2.40	2.35	0.05
Third week	2.39	2.32	0.07
Fourth week	2.33	2.28	0.05
August.			
First week	2.29	2.27	0.02
Second week	2.29	2.21	0.08
Third week	2.35	2.24	0.11
Fourth week	2.38	2.35	0.03
September.			
First week	2.46	2.39	0.07
Second week	2.51	2.42	0.09
Third week	2.59	2.44	0.15
Fourth week	2.72	2.61	0.11
October.			
First week	2.76	2.59	0.17
Second week	2.80	2.68	0.18
Third week	2.83	2.70	0.13
Fourth week	2.81	2.72	0.09

From the table above, we can see that there is a larger amount of casein in the milk than there is casein and albumen in the cheese. If we assume that all the albumen goes into the whey and none into the cheese, then the excess of casein found in the milk over that found in the cheese would represent the amount of casein lost in the whey in the process of cheese-making. On this assumption, the amount of casein lost in the whey varied from 0.02 to 0.18 pounds, and averaged 0.07 pounds for 100 pounds of milk.

IV. General Summary of Results Relating to Loss and Recovery of Milk Constituents in Cheese-Making.

1. *Amount of milk-solids lost and recovered in cheese-making.*

a. Pounds of milk-solids lost in whey for 100 pounds of milk.

	Least.	Greatest.	Average.
Season of 1892	5.81	6.83	6.21
Season of 1893	6.09	6.49	6.27
Seasons of 1892 and 1893	5.81	6.83	6.25

b. Pounds of milk-solids recovered in cheese for 100 pounds of milk.

	Least.	Greatest.	Average.
Season of 1892	5.31	7.58	6.43
Season of 1893	5.55	6.50	6.35
Seasons of 1892 and 1893	5.31	7.58	6.38

c. Per cent. of solids in milk lost in whey.

	Least.	Greatest.	Average.
Season of 1892	43.59	54.73	49.13
Season of 1893	45.34	53.40	49.68
Seasons of 1892 and 1893	43.59	54.73	49.48

d. Per cent. of solids in milk recovered in cheese.

	Least.	Greatest.	Average.
Season of 1892	45.27	56.43	50.87
Season of 1893	46.60	54.66	50.32
Seasons of 1892 and 1893	45.27	56.43	50.52

e. The proportion of milk-solids lost in the whey decreased from month to month as the season advanced while the proportion of milk-solids recovered in cheese increased. This was due to an increase of cheese-making solids (fat and casein) in the milk, since these increased from month to month with the advance of lactation, while the whey solids (albumen, sugar, etc.), remained quite uniform in amount, as compared with the fat and casein.

2. *Amount of fat in milk lost and recovered in cheese-making.*

a. Pounds of fat lost in whey for 100 pounds of milk.

	Least.	Greatest.	Average.
Season of 1892	0.21	0.45	0.31
Season of 1893	0.22	0.50	0.34
Seasons of 1892 and 1893	0.21	0.50	0.33

b. Pounds of fat recovered in cheese for 100 pounds of milk.

	Least.	Greatest.	Average.
Season of 1892	2.77	4.03	3.38
Season of 1893	2.94	4.05	3.39
Seasons of 1892 and 1893	2.77	4.05	3.39

c. Per cent. of fat in milk lost in whey.

	Least.	Greatest.	Average.
Season of 1892	5.68	12.86	8.40
Season of 1893	5.80	13.51	9.12
Seasons of 1892 and 1893	5.68	13.51	8.87

d. Per cent. of fat in milk recovered in cheese.

	Least.	Greatest.	Average.
Season of 1892	87.14	94.32	91.60
Season of 1893	86.49	94.20	90.88
Seasons of 1892 and 1893	86.49	94.32	91.13

e. The smallest proportion of fat lost in June, with October second, when the milk was richest in fat; while the largest proportion of fat lost was in April or May when the amount of fat in the milk was least. The results of our two years' work all go to show that the proportion of fat lost in cheese-making is quite independent of the amount of fat in the milk. The variations that occur in loss of fat are due either to the conditions of the milk or to some special conditions employed in manufacture.

3. *Amount of casein and albumen in milk lost and recovered in cheese-making.*

a. Pounds of casein and albumen lost in whey for 100 pounds of milk.

	Least.	Greatest.	Average.
Season of 1892	0.61	0.94	0.75
Season of 1893	0.58	0.88	0.76
Seasons of 1892 and 1893	0.58	0.94	0.76

b. Pounds of casein and albumen recovered in cheese for 100 pounds of milk.

	Least.	Greatest.	Average.
Season of 1892	1.90	2.82	2.38
Season of 1893	2.07	2.76	2.37
Seasons of 1892 and 1893	1.90	2.82	2.37

c. Per cent. of casein and albumen in milk lost in whey.

	Least.	Greatest.	Average.
Season of 1892	22.07	25.00	23.96
Season of 1893	20.00	26.30	24.28
Seasons of 1892 and 1893	20.00	26.30	24.28

d. Per cent. of casein and albumen in milk recovered in cheese.

	Least.	Greatest.	Average.
Season of 1892	75.00	77.93	76.04
Season of 1893	73.70	80.00	75.72
Seasons of 1892 and 1893	73.70	80.00	75.72

e. The proportion of casein and albumen lost in cheese-making has been found to be very uniform and quite independent of variation in conditions of manufacture. The amount of albumen in milk largely determines the amount of casein and albumen lost in whey, since there is very little casein lost. On the other hand, the amount of casein recovered in cheese closely follows the amount of casein in the milk and is governed by this more than by conditions of manufacture.

4. Tabulated Averages Showing Loss and Recovery of Milk-Constituents in Cheese-Making.

	Pounds in 100 lbs. of milk.	Pounds lost in whey for 100 lbs. of milk.	Pounds recovered in cheese for 100 lbs. of milk.	Per cent. lost in whey.	Per cent. recovered in cheese.
Solids in milk, 1892	12.64	6.21	6.43	49.13	50.87
1893.					
Stone's factory	12.58	6.28	6.30	49.92	50.08
Merry's factory	12.46	6.25	6.21	50.16	49.84
Forty-eight factories	12.72	6.28	6.44	49.37	50.63
Season of 1893	12.62	6.27	6.35	49.68	50.32
Seasons of 1892 and 1893	12.63	6.25	6.38	49.48	50.52
Fat in milk, 1892	3.69	0.31	3.38	8.40	91.60
1893.					
Stone's factory	3.71	0.37	3.34	9.97	90.03
Merry's factory	3.67	0.33	3.34	9.00	91.00
Forty-eight factories	3.77	0.34	3.43	9.02	90.98
Season of 1893	3.73	0.34	3.39	9.12	90.88
Seasons of 1892 and 1893	3.72	0.33	3.39	8.87	91.13
Casein and albumen in milk, 1892	3.13	0.75	2.38	23.96	76.04
1893.					
Stone's factory	3.09	0.74	2.35	23.95	76.05
Merry's factory	3.03	0.74	2.29	24.42	75.58
Forty-eight factories	3.17	0.77	2.40	24.29	75.71
Season 1892	3.13	0.76	2.37	24.28	75.72
Seasons of 1892 and 1893	3.13	0.76	2.37	24.28	75.72

XVI. RELATION OF COMPOSITION OF MILK TO YIELD OF CHEESE.

Under this head the following points will be considered:

1. Yield of green cheese from 100 pounds of milk.
2. Pounds of milk required to make one pound of green cheese.
3. Amount of water retained in cheese made from 100 pounds of milk.
4. Amount of fat retained in cheese made from 100 pounds of milk.
5. Amount of casein retained in cheese made from 100 pounds of milk.
6. Relation of fat in milk to yield of cheese.
7. General summary of results.

TABLE SHOWING RELATION OF MILK CONSTITUENTS TO YIELD OF CHEESE.

1893.	Pounds of fat in 100 lbs. of milk.	Pounds of casein in 100 lbs. of milk.	Pounds of green cheese made from 100 lbs. of milk.	Pounds of water in cheese made from 100 lbs. of milk.	Pounds of fat in cheese made from 100 lbs. of milk.	Pounds of casein in cheese made from 100 lbs. of milk.	Pounds of ash, etc., in cheese made from 100 lbs. of milk.
April.							
Second week	3.43	2.34	9.38	3.57	3.13	2.18	0.50
Third week	3.47	2.30	9.36	3.55	3.07	2.13	0.61
Fourth week	3.40	2.24	9.26	3.52	3.04	2.14	0.56
Average for April	3.43	2.29	9.32	3.56	3.07	2.15	0.54
May.							
First week	3.46	2.23	9.72	3.86	3.10	2.14	0.62
Second week	3.46	2.27	9.41	3.55	3.12	2.17	0.57
Third week	3.60	2.34	9.44	3.35	3.22	2.30	0.57
Fourth week	3.81	2.56	10.30	3.76	3.44	2.49	0.61
Average for May	3.67	2.43	9.87	3.66	3.31	2.35	0.59
June.							
First week	3.67	2.48	9.97	3.55	3.36	2.46	0.60
Second week	3.53	2.49	9.60	3.40	3.20	2.44	0.56
Third week	3.73	2.48	10.05	3.61	3.42	2.43	0.59
Fourth week	3.63	2.47	10.02	3.65	3.39	2.42	0.56
Average for June	3.66	2.48	9.95	3.58	3.37	2.43	0.57

July.							
First week	3.50	2.41	9.58	3.46	3.22	2.35	0.55
Second week	3.60	2.40	9.78	3.54	3.28	2.35	0.61
Third week	3.64	2.39	9.95	3.73	3.31	2.32	0.59
Fourth week	3.65	2.33	9.74	3.58	3.31	2.28	0.57
Average for July	3.62	2.38	9.83	3.63	3.30	2.31	0.59
August.							
First week	3.73	2.29	10.07	3.78	3.42	2.27	0.60
Second week	3.73	2.29	9.67	3.49	3.37	2.21	0.60
Third week	3.79	2.35	10.20	3.89	3.44	2.24	0.63
Fourth week	3.99	2.38	10.41	3.83	3.63	2.35	0.60
Average for August	3.87	2.35	10.21	3.79	3.52	2.30	0.60
September.							
First week	4.03	2.46	10.79	4.10	3.62	2.39	0.68
Second week	4.00	2.51	10.32	3.67	3.62	2.42	0.61
Third week	4.00	2.59	10.64	4.98	3.68	2.44	0.54
Fourth week	4.20	2.72	11.25	4.20	3.79	2.61	0.65
Average for September	4.06	2.56	10.77	4.00	3.67	2.46	0.64
October.							
First week	4.20	2.76	11.15	4.03	3.84	2.59	0.59
Second week	4.25	2.80	11.30	4.16	3.81	2.62	0.71
Third week	4.35	2.83	11.98	4.62	3.98	2.70	0.68
Fourth week	4.25	2.81	12.20	4.89	3.91	2.72	0.68
Average for October	4.27	2.81	11.86	4.59	3.91	2.68	0.68

I. Yield of Green Cheese from 100 Pounds of Milk.

TABLE SHOWING POUNDS OF GREEN CHEESE MADE FROM 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	8.47	9.95	9.50	9.40	9.63	11.40	....
Greatest	......	9.13	10.38	10.29	10.60	10.29	12.28	....
Average	......	8.75	9.87	9.96	10.03	9.91	11.84	10.06
1893.								
Stone's factory:								
Least	9.10	9.25	9.54	9.63	9.62	10.25	......	....
Greatest	9.76	10.19	10.06	9.92	10.47	10.76	......	....
Average	9.43	9.78	9.79	9.84	10.13	10.50	......	9.90
Merry's factory:								
Least	9.20	9.18	9.70	9.53	9.72	10.38	.....	....
Greatest	9.30	10.07	10.04	9.77	10.34	11.19	......	....
Average	9.24	9.63	9.83	9.59	10.00	10.70	......	9.90
Forty-eight factories:								
Least	9.13	8.94	9.38	9.58	10.08	11.03	11.15	....
Greatest	9.58	11.00	10.43	10.58	10.86	11.30	13.17	....
Average	9.34	10.02	10.05	9.93	10.44	11.17	11.86	10.25
Average for 1893	9.32	9.87	9.95	9.83	10.21	10.77	11.86	10.09
Average for 1892 and 1893	9.32	9.65	9.92	9.87	10.15	10.27	11.85	10.08

TABULATED GENERAL SUMMARY.

Pounds of green cheese made from 100 pounds of milk.

	Least.	Greatest.	Average.
Season of 1892	8.47	12.28	10.06
Season of 1893:			
Stone's factory	9.10	10.76	9.90
Merry's factory	9.10	11.19	9.90
Forty-eight factories	8.94	13.17	10.25
Average for 1892 and 1893	......	......	10.08

a. During the seasons of 1892 and 1893, the amount of green cheese made from 100 pounds of milk varied from 8.47 to 13.17 pounds, and averaged 10.08 pounds.

b. The amount of cheese made from 100 pounds of milk increased from month to month as the season advanced, because the per cent. of cheese-making constituents (fat and casein) increased in the milk.

c. The average amount of cheese made from 100 pounds of milk in 1893 would have been greater if the work had continued through October at the factories of Mr. Stone and Mr. Merry since the yield of cheese is highest in October.

II. Pounds of Milk Required to Make One Pound of Green Cheese.

TABLE SHOWING POUNDS OF MILK REQUIRED TO MAKE ONE POUND OF GREEN CHEESE.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	10.95	9.63	9.72	9.43	9.72	8.14	....
Greatest	......	11.81	10.36	10.53	10.64	10.38	8.95	....
Average	......	11.43	10.13	10.04	9.97	10.10	8.45	9.94
1893.								
Stone' factory:								
Least	10.24	9.82	9.94	10.08	9.55	9.29	......	....
Greatest	10.99	10.80	10.48	10.39	10.40	9.75	......	....
Average	10.60	10.22	10.21	10.17	9.87	9.52	......	10.10
Merry's factory:								
Least	10.75	9.93	9.96	10.23	9.67	8.94	......	....
Greatest	10.87	10.98	10.31	10.50	10.29	9.63	......	....
Average	10.82	10.38	10.17	10.43	10.00	9.35	......	10.10
Forty-eight factories:								
Least	10.44	9.09	9.59	9.36	9.21	8.85	7.60	....
Greatest	10.95	11.19	10.66	10.44	9.92	9.07	8.97	....
Average	10.71	9.98	9.95	10.07	9.58	8.95	8.43	9.76
Average for 1893	10.73	10.13	10.05	10.17	9.80	9.29	8.43	9.91
Average for 1892 and 1893	10.73	10.36	10.08	10.13	9.85	9.74	8.44	9.92

TABULATED GENERAL SUMMARY.

Pounds of water in 100 pounds of green cheese.

	Least.	Greatest.	Average.
Season of 1892	8.14	11.81	9.94
Season of 1893:			
Stone's factory	9.29	10.99	10.10
Merry's factory	8.94	10.98	10.10
Forty-eight factories	7.60	11.19	9.76
Average for 1892 and 1893	......	......	9.92

a. During the seasons of 1892 and 1893, the amount of milk required to make one pound of green cheese varied from 7.6 to 11.81 pounds, and averaged 9.92 pounds.

b. The amount of milk required to make one pound of green cheese decreased from month to month as the season advanced, because the per cent. of cheese-making constituents (fat and casein) increased in the milk.

III. Amount of Water Retained in Green Cheese Made From 100 Pounds of Milk.

TABLE SHOWING POUNDS OF WATER RETAINED IN GREEN CHEESE MADE FROM 100 POUNDS OF MILK.

	April.	May.	June.	July.	August.	September.	October.	Average for season.
1892.								
Least	.....	3.16	3.42	3.22	3.19	3.32	4.22	.....
Greatest	.....	3.35	4.01	3.67	3.93	3.87	4.76	.....
Average	.....	3.25	3.62	3.48	3.58	3.60	4.45	3.66
1893. Stone's factory:								
Least	3.37	3.32	3.21	3.36	3.44	3.50	.....	.....
Greatest	3.83	3.76	3.70	3.72	4.03	4.13	.....	.....
Average	3.60	3.56	3.38	3.58	3.80	3.81	.....	3.62
Merry's factory:								
Least	3.40	3.40	3.56	3.48	3.54	3.84	.....	.....
Greatest	3.49	3.72	3.72	3.52	3.69	4.10	.....	.....
Average	3.44	3.54	3.62	3.50	3.65	3.96	.....	3.62
48 factories:								
Least	3.46	3.11	3.25	3.47	3.64	4.22	4.03	.....
Greatest	3.71	4.32	3.98	4.06	4.32	4.30	5.78	.....
Average	3.59	3.74	3.63	3.72	3.92	4.26	4.59	3.85
Average for 1893	3.56	3.66	3.58	3.63	3.79	4.00	4.59	3.75
Average for 1892 and 1893	3.56	3.58	3.59	3.58	3.72	3.77	4.51	3.72

TABULATED GENERAL SUMMARY.

Pounds of water retained in cheese made from 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	3.16	4.76	3.66
Season of 1893:			
Stone's factory	3.21	4.13	3.62
Merry's factory	3.40	4.10	3.62
Forty-eight factories	3.11	5.78	3.85
Average for 1892 and 1893	......	......	3.72

a. The amount of water retained in the green cheese made from 100 pounds of milk varied from 3.11 to 5.78 pounds and averaged 3.72 pounds during the seasons of 1892 and 1893.

b. The amount of water retained in the cheese made from 100 pounds of milk naturally increased from month to month as the season advanced, because there was an increase of fat and casein, which enabled the cheese made from 100 pounds of milk to retain an increased amount of water.

IV. Amount of Fat Retained in Green Cheese Made From 100 Pounds of Milk.

TABLE SHOWING POUNDS OF FAT IN GREEN CHEESE MADE FROM 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average for season.
Least	.....	2.77	3.24	3.05	3.18	3.19	3.67	......
Greatest	.....	3.07	3.48	3.49	3.71	3.60	4.03	....
Average	.....	2.91	3.31	3.32	3.45	3.46	3.83	3.38
1893. Stone's factory:								
Least	3.01	3.13	3.24	3.24	3.37	3.54	.....	......
Greatest	3.13	3.43	3.49	3.37	3.52	3.62	.....	......
Average	3.07	3.25	3.36	3.31	3.47	3.58	....	3.34
Merry's factory:								
Least	3.07	2.95	3.20	3.19	3.34	3.59	.....	......
Greatest	3.13	3.45	3.36	3.27	3.72	3.81	.....	......
Average	3.10	3.24	3.30	3.24	3.47	3.68	.....	3.34
48 factories:								
Least	2.99	2.94	3.04	3.17	3.40	3.74	3.81	......
Greatest	3.11	3.67	3.49	3.48	3.79	3.78	4.05	......
Average	3.05	3.33	3.39	3.30	3.59	3.76	3.91	3.43
Average for 1893	3.07	3.3[illegible]	3.37	3.30	3.52	3.67	3.91	3.39
Average for 1892 and 1893	3.07	3.23	3.35	3.31	3.50	3.55	3.87	3.39

TABULATED GENERAL SUMMARY.

Pounds of fat retained in green cheese made from 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	2.77	4.03	3.38
Season of 1893:			
Stone's factory	3.01	3.62	3.34
Merry's factory	2.95	3.81	3.34
Forty-eight factories	2.94	4.05	3.43
Average for 1892 and 1893	....	....	3.39

a. The amount of fat retained in the cheese made from 100 pounds of milk varied from 2.77 to 4.05 pounds and averaged 3.39 pounds during the season of 1892 and 1893.

b. The amount of fat retained in the cheese increased from month to month during the season, when the amount of fat in the milk increased.

V. Amount of Casein Retained in Green Cheese Made from 100 Pounds of Milk.

TABLE SHOWING POUNDS OF CASEIN RETAINED IN CHEESE MADE FROM 100 POUNDS OF MILK.

1892.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Average for season.
Least	.....	1.90	2.41	2.31	2.27	2.32	2.71	......
Greatest	.....	2.10	2.51	2.39	2.36	2.46	2.82	......
Average	.....	2.01	2.47	2.35	2.31	2.38	2.78	2.38
1893. Stone's factory:								
Least	2.14	2.32	2.43	2.28	2.22	2.36	.....	......
Greatest	2.15	2.52	2.49	2.43	2.32	2.45	.....	......
Average	2.15	2.41	2.47	2.36	2.27	2.40	.....	2.35
Merry's factory:								
Least	2.10	2.07	2.31	2.22	2.19	2.37	.....	......
Greatest	2.17	2.47	2.43	2.29	2.34	2.62	.....	......
Average	2.13	2.28	2.37	2.26	2.26	2.46	.....	2.29
48 factories:								
Least	2.12	2.12	2.31	2.21	2.27	2.43	2.59	......
Greatest	2.21	2.59	2.52	2.48	2.37	2.60	2.76	......
Average	2.16	2.35	2.45	2.33	2.34	2.52	2.68	2.40
Average for 1893	2.15	2.35	2.43	2.31	2.30	2.46	2.68	2.37
Average for 1892 and 1893	2.15	2.28	2.44	2.32	2.30	2.41	2.73	2.37

TABULATED GENERAL SUMMARY.

Pounds of casein retained in cheese made from 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	1.90	2.82	2.38
Season of 1893:			
Stone's factory	2.14	2.52	2.35
Merry's factory	2.07	2.62	2.29
Forty-eight factories	2.12	2.76	2.40
Seasons of 1892 and 1893	......	......	2.37

a. During the seasons of 1892 and 1893, the amount of casein retained in the cheese made from 100 pounds of milk varied from 1.9 to 2.82 pounds and averaged 2.37 pounds.

b. The amount of casein retained in cheese increased when the amount of casein in the milk increased.

VI. Relation of Fat in Milk to Yield of Cheese.

The relation of fat in milk to yield of cheese has become one of the most important of dairy questions, because upon the uniformity of this relation depends the justice of using fat in milk as a basis in paying for milk at factories. This Station was the first to call attention to this relation and to show that the results secured in our work went far toward establishing the fact that, in normal factory milk, the fat is a fairly accurate measure of the amount of cheese that can and should be made from milk. In determining the yield of cheese, there are three different factors to be considered. First and primarily, the composition of the milk determines how much cheese it can make. The yield should increase or diminish in proportion as its fat and casein increase or diminish. Second, the condition of the milk affects the yield, by which is meant condition as regards sweetness, freedom from taint, etc. Third, the conditions employed in the process of manufacture affect yield, and these conditions, by which the losses of fat and casein and the retention of moisture are controlled, depend largely upon the skill of the maker. If milk were always in perfect condition and if our knowledge of cheese-making were complete enough to enable cheese-makers to control every step of his operations, then the yield of cheese would depend upon the composition of the milk.

Now, it is well known that two and only two constituents of milk generally need to be considered in relation to cheese; these two constituents are fat and casein. If the fat and casein are present in milk in uniform relative proportions, then the relation of fat to yield will be a uniform one. If the relation of fat to casein varies, then the relation of fat to yield of cheese will vary similarly. In previous bulletins, we have tried to calculate the yield of cheese based on the composition of the milk and eliminate the other two factors mentioned above. Our method was to calculate the amount of water in the cheese so that it would be proportional to the solids. This method was fairly satisfactory, but was open to one objection, viz.: that the fat and casein of cheese do not retain moisture with equal power. It was suggested to the writer by Dr. S. M. Babcock, of the Wisconsin station, that fat should have credited to it the same producing power that it has when made into butter and that likewise casein should have credited to it the same producing power that it has when made into cheese without fat. It was further suggested by Dr. Babcock that some of his experiments indicated that the cheese yield could be roughly calculated from the composition of the milk by multiplying the fat by 1.1 and the casein by 2.5 and adding the products, though he had no analytical data to show how nearly correct this might be. The writer adopted this suggestion as a basis for experiment. Preparing some pure casein, this was dried and then allowed to soak up as much water as it would be likely to hold in being made into green cheese. It was found that one pound of casein takes up water enough to increase its weight to 2.25 pounds. If to this is added the amount of ash taken up in the same amount of cheese, the weight would be increased to just about 2.5 pounds. This process of calculating cheese yield has been applied to all our work and with most satisfactory results. We shall present yields of cheese calculated in the above manner alongside the actual yields found, for the sake of comparison. The method has the additional advantage of being applicable to skim-milk or milk containing added cream with just as satisfactory results as when applied to normal milk.

Table Showing Pounds of Green Cheese Made for One Pound of Fat in Milk.

1893.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of green cheese made from 100 pounds of milk.	Pounds of cheese made for one pound of fat in milk.	Pounds of cheese calculated for 100 pounds of milk.	Pounds of calculated cheese for one pound of fat in milk.
April.						
Second week........	3.43	2.34	9.38	2.73	9.62	2.80
Third week	3.47	2.30	9.36	2.70	9.57	2.76
Fourth week........	3.40	2.24	9.26	2.72	9.34	2.75
Average for April..	3.43	2.29	9.32	2.72	9.50	2.77
May.						
First week..........	3.46	2.23	9.72	2.81	9.38	2.71
Second week........	3.46	2.27	9.41	2.72	9.48	2.74
Third week	3.60	2.34	9.44	2.62	9.81	2.73
Fourth week........	3.81	2.56	10.30	2.70	10.59	2.78
Average for May..	3.67	2.43	9.87	2.70	10.11	2.76
June.						
First week..........	3.67	2.48	9.97	2.72	10.24	2.79
Second week........	3.53	2.49	9.60	2.72	10.11	2.86
Third week.	3.73	2.48	10.05	2.70	10.30	2.76
Fourth week........	3.63	2.47	10.02	2.76	10.17	2.80
Average for June..	3.66	2.48	9.95	2.72	10.22	2.80
July.						
First week..........	3.50	2.41	9.58	2.74	9.88	2.82
Second week........	3.60	2.40	9.78	2.71	9.96	2.77
Third week	3.64	2.39	9.95	2.73	9.98	2.74
Fourth week.... ...	3.65	2.33	9.74	2.67	9.81	2.70
Average for July..	3.62	2.38	9.83	2.72	9.93	2.74
August.						
First week..........	3.73	2.29	10.07	2.70	9.84	2.64
Second week........	3.73	2.29	9.67	2.60	9.84	2.64
Third week	3.79	2.35	10.20	2.70	10.04	2.65
Fourth week........	3.99	2.38	10.41	2.61	10.34	2.60
Average for Aug...	3.87	2.35	10.21	2.64	10.13	2.62

TABLE SHOWING POUNDS OF GREEN CHEESE MADE FOR ONE POUND OF FAT IN MILK — (*Concluded*).

1893.	Pounds of fat in 100 pounds of milk.	Pounds of casein in 100 pounds of milk.	Pounds of green cheese made from 100 pounds of milk.	Pounds of cheese made made for one pound of fat in milk.	Pounds of cheese calculated for 100 pounds of milk.	Pounds of calculated cheese for one pound of fat in milk.
September.						
First week..........	4.03	2.46	10.79	2.68	10.58	2.63
Second week........	4.00	2.51	10.32	2.58	10.68	2.67
Third week	4.00	2.59	10.64	2.66	10.88	2.72
Fourth week........	4.20	2.72	11.25	2.68	11.42	2.71
Average for Sept ..	4.06	2.56	10.77	2.65	10.87	2.68
October.						
First week..........	4.20	2.76	11.15	2.66	11.52	2.74
Second week........	4.25	2.80	11.30	2.66	11.68	2.75
Third week	4.35	2.83	11.98	2.75	11.86	2.73
Fourth week........	4.25	2.81	12.20	2.87	11.70	2.75
Average for Oct...	4.27	2.81	11.86	2.78	11.72	2.74

TABLE SHOWING POUNDS OF CHEESE MADE FOR ONE POUND OF FAT IN MILK.

1892.	April.	May.	June.	July.	August.	September.	October.	Average for season.
Least	......	2.60	2.61	2.64	2.53	2.52	2.77	....
Greatest	......	2.80	2.83	2.86	2.91	2.72	2.96	....
Average	......	2.73	2.76	2.74	2.66	2.60	2.86	2.73
1893.								
Stone's factory:								
Least	2.68	2.57	2.60	2.67	2.57	2.56	......	....
Greatest	2.75	2.68	2.80	2.72	2.72	2.69	......	....
Average	2.72	2.65	2.66	2.70	2.66	2.62	.....	2.67
Merry's factory:								
Least	2.60	2.63	2.71	2.64	2.52	2.60	......	....
Greatest	2.70	2.76	2.77	2.76	2.70	2.66	......	....
Average	2.68	2.71	2.75	2.70	2.62	2.64	......	2.70
Forty-eight factories:								
Least	2.72	2.56	2.58	2.69	2.54	2.70	2.61	....
Greatest	2.78	2.85	2.89	2.81	2.78	2.70	3.06	....
Average	2.76	2.72	2.73	2.74	2.65	2.70	2.78	2.72
Average for 1893	2.72	2.70	2.72	2.74	2.62	2.68	2.74	2.71
Average for 1892 and 1893	2.72	2.70	2.73	2.74	2.64	2.62	2.81	2.72

TUBULATED GENERAL SUMMARY.

Pounds of cheese made for one pound of fat in milk.

	Least.	Greatest.	Average.
Season for 1892	2.53	2.96	2.73
Season of 1893:			
Stone's factory	2.56	2.80	2.67
Merry's factory	2.52	2.77	2.70
Forty-eight factories	2.54	3.06	2.72
Average for 1892 and 1893	......	......	2.72

a. During the seasons of 1892 and 1893, the amount of green cheese made for one pound of fat in milk varied from 2.52 to 3.06 pounds and averaged 2.72 pounds.

b. The results were fairly uniform from month to month.

c. The slightly lower results given than in the average of our work last year are accounted for by a larger loss of fat and retention of less water. Moreover, the drying up of pastures affected the yield, and the discontinuation of the work in the middle of September instead of carrying through October lowered the average necessarily.

d. The average difference between the actual and calculated yield of cheese was 0.03 pounds for one pound of fat in milk.

VII. General Summary of Results Relating to Influence of Composition of Milk on Yield of Green Cheese.

1. *Yield of green cheese from* 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	8.47	12.28	10.06
Season of 1893	8.94	13.17	10.09
Seasons of 1892 and 1893	8.47	13.17	10.08

2. *Pounds of milk required to make one pound of green cheese.*

	Least.	Greatest.	Average.
Season of 1892	8.14	11.81	9.94
Season of 1893	7.60	11.19	9.91
Seasons of 1892 and 1893	7.60	11.81	9.92

3. *Pounds of water retained in green cheese made from* 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	3.16	4.76	3.66
Season of 1893	3.11	5.78	3.75
Seasons of 1892 and 1893	3.11	5.78	3.72

4. *Pounds of fat retained in green cheese made from* 100 *pounds of milk.*

	Least.	Greatest.	Average.
Season of 1892	2.77	4.03	3.38
Season of 1893	2.94	4.05	3.39
Seasons of 1892 and 1893	2.77	4.05	3.39

5. *Pounds of casein retained in cheese made from* 100 *pounds of milk.*

	Least.	Greatest.	Average
Season of 1892	1.90	2.82	2.38
Season of 1893	2.07	2.76	2.37
Seasons of 1892 and 1893	1.90	2.82	2.37

6. *Pounds of green cheese made for one pound of fat in milk.*

	Least.	Greatest.	Average.
Season of 1892	2.63	2.96	2.73
Season of 1893	2.52	3.06	2.71
Seasons of 1892 and 1893	2.52	3.06	2.72

XVII. GENERAL SUMMARY OF RESULTS OF THE WORK DONE IN CHEESE FACTORIES DURING THE SEASONS OF 1892 AND 1893.

I. Extent of Investigation.

1. *Amount of work done.*

a. In 1892 work was done at five different cheese factories one week each month from May to October, cheese being made fifty times in all.

b. In 1893 work was done at fifty different cheese factories, located in eight counties, from April on through October, cheese being made 100 times in all. At the factories of Mr. Stone and of Mr. Merry work was done one day each week through the season.

2. *Amount of milk used.*

The amount of milk actually handled in all the work aggregated nearly one million pounds, which represented the average of not less than 5,000,000 pounds of milk, the product of not less than 15,000 different cows.

3. *Amount of chemical work done.*

In 1892 there was a total of 4,466 determinations; in 1893 of 7,095; total for two seasons, 11,561 determinations.

II. Conditions of Manufacture.

1. *Amount of rennet extract used.*

The amount of rennet extract used for 1,000 pounds of milk varied in 1892 from two to six ounces, and averaged three and one-third ounces; in 1893 from two to five ounces and averaged three ounces.

2. *Temperature of milk when rennet was added.*

The temperature of the milk when the rennet was added varied in 1892 from 82° Fahr. to 90° Fahr., and averaged 84¼° Fahr.; in 1893 from 80° Fahr. to 88° Fahr., and averaged 84½° Fahr.

3. *Time required for rennet to coagulate completely.*

The time required for the rennet to coagulate the milk completely varied in 1892 from fourteen to forty minutes, and averaged twenty-five minutes; in 1893 from five to seventy-eight minutes and averaged thirty-two minutes.

4. *Temperature to which curd was heated after being cut.*

The temperature to which the curd was heated after being cut varied in 1892 from 97° Fahr. to 106° Fahr., and averaged 98½° Fahr.; in 1893 from 95° Fahr. to 105° Fahr., and averaged 99° Fahr.

5. *Time from cutting curd to drawing whey.*

The time from cutting curd to drawing whey varied in 1892 from one hour and twenty-three minutes to four hours and twenty-five minutes, and averaged two hours and forty-five minutes; in 1893 from one hour and twenty-five minutes to five hours and thirty minutes, and averaged three hours and eighteen minutes.

6. *Length of string on hot iron when whey was drawn.*

The length of string formed on a hot iron when the whey was drawn varied in 1893 from a trace to one and one-fourth inch, and averaged one-fourth inch.

7. *Time from drawing whey to putting curd in press.*

The time from drawing whey to putting curd in press varied in 1892 from one hour to four hours and forty minutes, and averaged two hours and forty-two minutes; in 1893 from forty minutes to six hours and fifteen minutes, and averaged one hour and fifty-three minutes.

8. *Length of string on hot iron when curd was put in press.*

The length of string formed on a hot iron when the curd was put in press varied in 1893 from one-half inch to four inches, and averaged one and one-half inches.

9. *Temperature of curd when put in press.*

The temperature of the curd when put in press varied in 1893 from 70° Fahr. to 90° Fahr. and averaged 81° Fahr.

10. *Time consumed in operation of cheese-making after adding rennet.*

The time consumed in the operation of cheese-making after adding rennet varied, in 1893, from two hours and twelve minutes to nine hours and fifty minutes and averaged six hours.

III. The Composition of Normal Factory Milk.

1. *Pounds of solids in* 100 *pounds of milk.*

The milk-solids in 100 pounds of milk varied in 1892 from 11.47 to 13.91 pounds, and averaged 12.64 pounds; in 1893, from 11.7 to 13.87 pounds, and averaged 12.68 pounds; in 1892 and 1893 averaged 12.67 pounds.

2. *Pounds of solids not fat in* 100 *pounds of milk.*

The solids not fat in 100 pounds of milk varied in 1892 from 8.27 to 9.66 pounds, and averaged 8.94 pounds; in 1893, from 8.4 to 9.35 pounds, and averaged 8.91 pounds; in 1892 and 1893 averaged 8.92 pounds.

3. *Pounds of cheese-producing solids (fat and casein) in* 100 *pounds of milk.*

The amount of cheese-producing solids (fat and casein) in 100 pounds of milk varied in 1892 from 4.97 to 7.35 pounds, and averaged 6.16 pounds; in 1893, from 5.48 to 7.44 pounds, and averaged 6.23 pounds; in 1892 and 1893 averaged 6.21 pounds.

4. *Pounds of whey-solids (albumen, sugar, etc.) in* 100 *pounds of milk.*

The amount of whey-solids (albumen, sugar, etc.) in 100 pounds of milk varied in 1892 from 6.11 to 7.03 pounds, and averaged 6.48 pounds; in 1893, from 6.19 to 6.69 pounds, and averaged 6.45 pounds; in 1892 and 1893 averaged 6.46 pounds.

5. *Pounds of fat in* 100 *pounds of milk.*

The amount of fat in 100 pounds of milk varied in 1892 from 3.04 to 4.35 pounds, and averaged 3.69 pounds; in 1893, from 3.33 to 4.6 pounds, and averaged 3.77 pounds; in 1892 and 1893 averaged 3.75 pounds.

6. *Pounds of casein and albumen in* 100 *pounds of milk.*

The amount of casein and albumen in 100 pounds of milk varied in 1892 from 2.53 to 3.76 pounds, and averaged 3.13 pounds; in 1893 from 2.75 to 3.60 pounds, and averaged 3.14 pounds; in 1892 and 1893 averaged 3.14 pounds.

7. *Pounds of casein in* 100 *pounds of milk.*

The amount of casein in 100 pounds of milk varied in 1892 from 1.93 to 3 pounds, and averaged 2.47 pounds; in 1893 from 2.18 to 2.85 pounds, and averaged 2.46 pounds; in 1892 and 1893 averaged 2.46 pounds.

8. *Pounds of albumen in* 100 *pounds of milk.*

The amount of albumen in 100 pounds of milk varied in 1892 from 0.55 to 0.86 pounds, and averaged 0.66 pounds; in 1893 from 0.47 to 0.87 pounds, and averaged 0.68 pounds; in 1892 and 1893 averaged 0.68 pounds.

9. *Pounds of casein for one pound of albumen in milk.*

For each pound of albumen in normal milk the casein varied in 1892 from 2.60 to 4.60 pounds, and averaged 3.74 pounds; in 1893 from 2.80 to 5.58 pounds, and averaged 3.62 pounds; in 1892 and 1893 averaged 3.66 pounds.

10. *Pounds of fat for one pound of casein in normal milk.*

For each pound of casein in normal milk the fat varied in 1892 from 1.38 to 1.74 pounds, and averaged 1.5 pounds; in 1893 from 1.38 to 1.78 pounds, and averaged 1.53 pounds; in 1892 and 1893 averaged 1.52 pounds.

11. *Pounds of fat for one pound casein and albumen in normal milk.*

For each pound of casein in albumen in normal milk the fat varied in 1892 from 1.07 to 1.33 pounds, and averaged 1.18 pounds; in 1893, from 1.06 to 1.33 pounds, and averaged 1.2 pounds; in 1892 and 1893 averaged 1.19 pounds.

12. *Variation in the composition of milk during the season.*

The changes that normally take place in milk with advance of lactation were quite seriously interfered with by the conditions of weather, since about the middle of July the pastures began to suffer from drouth. The general effect was rapidly to diminish the flow of milk and the different constituents changed into abnormal relations. The fat increased while the casein and albumen diminished, the albumen decreasing in larger and relative proportion.

IV. The Composition of Whey.

1. *Pounds of solids in* 100 *pounds of whey.*

The amount of solids in 100 pounds of whey varied in 1892 from 6.43 to 7.52 pounds, and averaged 6.91 pounds; in 1893, from 6.72 to 7.25 pounds, and averaged 6.97 pounds; in 1892 and 1893 averaged 6.96 pounds.

2. *Pounds of fat in* 100 *pounds of whey*

The amount of fat in 100 pounds of whey varied in 1892 from 0.23 to 0.5 pounds, and averaged 0.34 pounds; in 1893, from 0.24 to 0.55 pounds, and averaged 0.38 pounds; in 1892 and 1893 averaged 0.36 pounds.

3. *Pounds of casein and albumen in* 100 *pounds of whey.*

The amount of casein and albumen in 100 pounds of whey varied in 1892 from 0.67 to 1.07 pounds, and averaged 0.84 pounds; in 1893, from 0.65 to 0.99 pounds, and averaged 0.84 pounds; in 1892 and 1893 averaged 0.84 pounds.

V. The Composition of Green Cheese made from Normal Milk.

1. *Pounds of water in* 100 *pounds of green cheese.*

The amount of water in 100 pounds of green cheese varied in 1892 from 33.5 to 38.8 pounds, and averaged 36.41 pounds; in 1893, from 32.69 to 43.89 pounds, and averaged 37.05 pounds; in 1892 and 1893 averaged 36.84 pounds.

2. *Pounds of solids in* 100 *pounds of green cheese.*

The amout of solids in 100 pounds of green cheese varied in 1892 from 61.2 to 66.5 pounds, and averaged 63.59 pounds; in 1893, from 56.11 to 67.31 pounds, and averaged 62.95 pounds; in 1892 and 1893 averaged 63.16 pounds.

3. *Pounds of fat in* 100 *pounds of green cheese.*

The amount of fat in 100 pounds of green cheese varied in 1892 from 31.9 to 36.79 pounds, and averaged 34.3 pounds; in 1893, from 30 to 35.98 pounds, and averaged 33.59 pounds; in 1892 and 1893 averaged 33.83 pounds.

4. *Pounds of casein in* 100 *pounds of green cheese.*

The amount of casein in 100 pounds of green cheese varied in 1892 from 23.18 to 26.1 pounds, and averaged 24.3 pounds; in 1893, from 20.8 to 26.11 pounds, and averaged 23.43 pounds; in 1892 and 1893 averaged 23.72 pounds.

5. *Pounds of fat for one pound of casein in cheese.*

The amount of fat for each pound of casein in cheese varied in 1892 from 1.27 to 1.54 pounds, and averaged 1.41 pounds; in 1893, from 1.27 to 1.6 pounds, and averaged 1.43 pounds; in 1892 and 1893 averaged 1.42 pounds.

6. *Pounds of fat in* 100 *pounds of cheese-solids.*

The amount of fat in 100 pounds of cheese-solids varied in 1892 from 50.39 to 56.83 pounds, and averaged 53.94 pounds; in 1893, from 51.01 to 56.15 pounds, and averaged 53.36 pounds; in 1892 and 1893 averaged 53.56 pounds.

7. *Pounds of solids not fat in* 100 *pounds of cheese-solids.*

The amount of solids not fat in 100 pounds of cheese-solids varied in 1892 from 43.17 to 49.61 pounds, and averaged 46.06 pounds; in 1893, from 43.85 to 48.99 pounds, and averaged 46.64 pounds; in 1892 and 1893 averaged 46.44 pounds.

8. *Pounds of fat for one pound of solids not fat in cheese.*

The amount of fat for one pound of solids not fat in cheese varied in 1892, from 1.01 to 1.32 pounds, and averaged 1.17 pounds; in 1893, from 1.04 to 1.28 pounds, and averaged 1.14 pounds; in 1892 and 1893, averaged 1.15 pounds.

VI. Loss of Milk-Constituents in Cheese-Making.

1. *Pounds of milk-solids lost in whey for* 100 *pounds of milk.*

The amount of milk-solids lost in whey for 100 pounds of milk varied in 1892, from 5.81 to 6.83 pounds, and averaged 6.21 pounds; in 1893, from 6.09 to 6.49 pounds, and averaged 6.27 pounds; in 1892 and 1893, averaged 6.25 pounds.

2. *Per cent. of solids in milk lost in whey.*

The per cent. of solids in milk lost in whey varied in 1892, from 43.59 to 54.73 per cent., and averaged 49.13 per cent.; in 1893, from 45.34 to 53.4 per cent., and averaged 49.68 per cent.; in 1892 and 1893, averaged 49.48 per cent.

3. *Influence of advance of season on loss of milk-solids.*

The proportion of milk-solids lost in the whey decreased from month to month as the season advanced, while the proportion of milk-solids recovered in cheese increased. This was due to an increase of cheese-making solids (fat and casein) in the milk, since these increased from month to month, while the whey-solids (albumen, sugar, etc.) remained quite uniform in amount, as compared with the fat and casein.

4. *Pounds of fat lost in whey for* 100 *pounds of milk.*

The amount of fat lost in whey for 100 pounds of milk varied in 1892, from 0.21 to 0.45 pounds and averaged 0.31 pounds; in 1893, from 0.22 to 0.5 pounds, and averaged 0.34 pounds; in 1892 and 1893, averaged 0.33 pounds.

5. *Per cent. of fat in milk lost in whey.*

The per cent. of fat in milk lost in whey varied in 1892, from 5.68 to 12.86 per cent., and averaged 8.4 per cent.; in 1893, from 5.8 to 13.51 per cent., and averaged 9.12 per cent.; in 1892 and 1893, averaged 8.87 per cent.

6. *Causes of variations in loss of fat in cheese-making.*

The smallest proportion of fat lost was in June and the next smaller proportion was in October, when the amount of fat in the milk was highest; while the largest proportion of fat lost was in April or May, when the amount of fat in the milk was least. All of our results go to show that the proportion of fat lost in cheese-making is quite independent of the amount of fat in the milk. The variations that occur in loss of fat are due either to the condition of the milk or to some special conditions employed in manufacture, or to both.

7. *Pounds of casein and albumen lost in whey for* 100 *pounds of milk.*

The amount of casein and albumen lost in whey for 100 pounds of milk varied in 1892 from 0.61 to 0.94 pounds, and averaged 0.75 pounds; in 1893, from 0.58 to 0.88, and averaged 0.76 pounds; in 1892 and 1893, averaged 0.76.

8. *Per cent. of casein and albumen in milk lost in whey.*

The per cent. of casein and albumen in milk lost in whey varied in 1892 from 22.07 to 25 per cent., and averaged 23.96 per cent.; in 1893, from 20 to 26.3 per cent., and averaged 24.28 per cent.; in 1892 and 1893, averaged 24.28 per cent.

9. *Variations in loss of casein and albumen in cheese-making.*

The proportion of casein and albumen lost in cheese-making has been found in this investigation to be very uniform and quite independent of variation in conditions of manufacture. The amount of albumen in milk largely determines the amount of casein and albumen lost in whey, since there is very little casein lost.

VII. Relation of Composition of Milk to Yield of Cheese.

1. *Yield of green cheese from* 100 *pounds of milk.*

The amount of green cheese made from 100 pounds of milk varied in 1892, from 8.47 to 12.28 pounds, and averaged 10.06 pounds; in 1893, from 8.94 to 13.17 pounds, and averaged 10.09 pounds; in 1892 and 1893, averaged 10.08 pounds.

2. *Pounds of milk required to make one pound of green cheese.*

The amount of milk required to make one pound of green cheese varied in 1892, from 8.14 to 11.81 pounds, and averaged 9.94 pounds; in 1893, from 7.6 to 11.19 pounds, and averaged 9.91 pounds; in 1892 and 1893, averaged 9.92 pounds.

3. *Pounds of water retained in green cheese made from* 100 *pounds of milk.*

The amount of water retained in the green cheese made from 100 pounds of milk varied in 1892, from 3.16 to 4.76 pounds, and averaged 3.66 pounds; in 1893, from 3.11 to 5.78 pounds, and averaged 3.75 pounds; in 1892 and 1893, averaged 3.72 pounds.

4. *Pounds of fat retained in green cheese made from* 100 *pounds of milk.*

The amount of fat retained in the green cheese made from 100 pounds of milk varied in 1892, from 2.77 to 4.03 pounds, and averaged 3.38 pounds; in 1893, from 2.94 to 4.05 pounds, and averaged 3.39 pounds; in 1892 and 1893, averaged 3.39 pounds.

5. *Pounds of casein retained in green cheese made from* 100 *pounds of milk.*

The amount of casein retained in the green cheese made from 100 pounds of milk varied in 1892, from 1.9 to 2.82 pounds, and averaged 2.38 pounds; in 1893, from 2.07 to 2.76 pounds, and averaged 2.37 pounds; in 1892 and 1893, averaged 2.37 pounds.

6. *Pounds of green cheese made for one pound of fat in milk.*

The amount of green cheese made for one pound of fat in milk varied in 1892, from 2.53 to 2.96 pounds, and averaged 2.73 pounds; in 1893, from 2.52 to 3.06 pounds, and averaged 2.71 pounds; in 1892 and 1893, averaged 2.72 pounds.

VIII. Tabulated Summary of Results.

1. Composition of Milk.

In 100 *pounds of milk.*

	1892-3.		1892.	1893.	1892-3.
	Least.	Greatest.	Average.	Average.	Average.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water	86.09	88.53	87.36	87.32	87.33
Total solids	11.47	13.91	12.64	12.68	12.67
Fat	3.04	4.60	3.69	3.77	3.75
Casein	1.93	3.00	2.47	2.46	2.46
Albumen	0.47	0.87	0.66	0.68	0.68
Sugar, ash, etc.	5.32	6.37	5.82	5.77	5.78
Pounds of casein for one pound of albumen	2.60	5.58	3.74	3.62	3.66
Pounds of fat for one pound of casein	1.38	1.78	1.50	1.53	1.52

2. Composition of Whey.

In 100 *pounds of whey.*

	1892-3.		1892.	1893.	1892-3.
	Least.	Greatest.	Average.	Average.	Average.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water	92.48	93.57	93.09	93.03	93.04
Total solids	6.43	7.52	6.91	6.97	6.96
Fat	0.23	0.55	0.34	0.38	0.36
Casein and albumen	0.65	1.07	0.84	0.84	0.84
Sugar, ash, etc.	5.39	6.43	5.73	5.75	5.76

3. COMPOSITION OF GREEN CHEESE.

In 100 pounds of green cheese.

	1892–3.		1892.	1893.	1892–3.
	Least.	Greatest.	Average.	Average.	Average.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water..............	32.69	43.89	36.41	37.05	36.84
Total solids..........	56.11	67.31	63.59	62.95	63.16
Fat..................	30.00	36.79	34.30	33.59	33.83
Casein and albumen ..	20.80	26.11	24.30	23.43	23.72
Sugar, ash, etc.......	3.12	7.02	4.99	5.93	5.61
Pounds of fat for one pound of casein	1.27	1.60	1.41	1.43	1.42

4. AMOUNT OF MILK-CONSTITUENTS LOST IN CHEESE-MAKING.

Lost in whey for 100 pounds of milk.

	1892–3.		1892.	1893.	1892–3.
	Least.	Greatest.	Average.	Average.	Average.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water..............	81.41	85.41	83.73	83.64	83.67
Total solids.........	5.81	6.83	6.21	6.27	6.25
Fat	0.21	0.50	0.31	0.34	0.33
Casein and albumen ..	0.58	0.94	0.75	0.76	0.76
Sugar, ash, etc.......	4.71	5.86	5.15	5.17	5.16
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Per cent. of solids in milk lost in whey ..	43.59	54.73	49.13	48.68	49.48
Per cent. of fat in milk lost in whey... ...	5.68	13.51	8.40	9.12	8.87
Per cent. of casein and albumen in milk lost in whey..........	20.00	26.30	23.96	24.28	24.28

5. AMOUNT OF MILK-CONSTITUENTS RECOVERED IN CHEESE-MAKING.

Recovered in cheese for 100 *pounds of milk.*

	1892-3.		1892.	1893.	1892-3.
	Least.	Greatest.	Average.	Average.	Average.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Water	3.11	5.78	3.66	3.75	3.72
Total solids	5.31	7.58	6.43	6.38	6.38
Fat	2.77	4.05	3.38	3.39	3.39
Casein and albumen	1.90	2.82	2.38	2.37	2.37
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Per cent. of solids in milk recovered in cheese	45.27	56.43	50.87	50.32	50.52
Per cent. of fat in milk recovered in cheese	86.49	94.32	91.60	90.88	91.13
Per cent. of casein and albumen in milk recovered in cheese	73.70	80.00	76.04	75.72	75.72

6. YIELD OF CHEESE AND WHEY.

	1892-3.		1892.	1893.	1892-3.
	Least.	Greatest.	Average.	Average.	Average.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Green cheese from 100 pounds of milk	8.47	13.17	10.06	10.09	10.08
Pounds of milk for one pound of green cheese	7.60	11.81	9.94	9.91	9.92
Pounds of whey from 100 pounds of milk	86.83	91.53	89.94	89.91	89.92
Pounds of green cheese made for one pound of fat in milk	2.52	3.06	2.73	2.71	2.72

XVIII. THE DETERMINATION OF CASEIN IN COWS' MILK (TECHNICAL).

The methods originally proposed by Hoppe-Seyler and Ritthausen have been commonly employed for the separation and determination of casein in cows' milk. In both methods, the milk is diluted with water and a small amount of acetic acid is added. The precipitation is rendered complete, in one case, by raising the temperature to 40° C., and, in the other case, by passing a current of carbon dioxide through the mixture at ordinary temperatures. The precipitate is filtered, washed first with water, and then with ether to remove fat and is finally dried and weighed on the filter. The absence of specific directions touching several steps of the operation led me to investigate some of the conditions pertaining to the determination of casein, among which were the following:

1. Comparison of the two methods.
2. Influence of amount of acid used in precipitating casein.
3. Use of different acids in precipitating casein.
4. Influence of temperature and time of digestion on precipitation of casein.
5. The precipitation of casein in fresh and in old milk.
6. The use of preservatives in keeping milk, and influence on the determination of casein.

The tedious method involved in washing the precipitated casein free from fat by ether and in subsequent drying and weighing on the filter paper was entirely discarded. The precipitated casein was washed by decantation and on the filter two or three times. The filter and contents were then treated by the ordinary Kjeldahl method for the determination of nitrogen, the factor 6.25 being used to convert the amount of nitrogen into an equivalent of casein, when this was desired. This use of the Kjeldahl method in determining the amount of casein was suggested and employed sometime since by several chemists and is now very generally used in the analysis of dairy-products. The advantages of its use over the old method in point of accuracy and simplicity are too evident and too well known to deserve further mention.

(1). *Comparison of results obtained by precipitating casein in milk at a temperature of* 40° *C. without carbon dioxide and with* *carbon dioxide at ordinary temperatures.*—The method employed in making the comparison was, briefly, as follows: About ten grams of milk were used in each case. This amount of milk was diluted with water at 40°–42° C. to 100 cc. and then 1.5 cc. of a solution containing ten per cent. of acetic acid were added and the solution was carefully stirred with a glass rod. The resulting precipitate was washed two or three times by decantation and on the filter; finally, the filter-paper and contents were digested according to the Kjeldahl method for determining nitrogen. In the other case, the milk was diluted to 100 cc. with water of the temperature of the room, then 1.5 cc. of the same dilute acetic acid as that employed above were added, after which a stream of carbon dioxide was passed through the solution, until the liquid above the precipitate was clear or very nearly so. The subsequent filtration, washing and determination of nitrogen were made as above.

The following results were obtained by the two methods with two different samples of milk, triplicate determinations being made in each case:

	Method A, precipitation at 40° C., sample No. 1.	Method B, precipitation with aid of carbon dioxide, sample No. 1.
(*a*) Per cent. nitrogen	0.475	0.486
(*b*) Per cent. nitrogen	0.474	0.480
(*c*) Per cent. nitrogen	0.469	0.461
Average	0.473	0.476
	Sample No. 2.	Sample No 2.
(*a*) Per cent. nitrogen	0.458	0.454
(*b*) Per cent. nitrogen	0.458	0.444
(*c*) Per cent. nitrogen	0.449	0.455
Average	0.455	0.451

Statement of results.—The above results indicate, first, that essentially the same results are obtained whether we precipitate the casein in cows' milk at a temperature of 40° C. without carbon dioxide, or at ordinary temperatures with the aid of carbon dioxide, other conditions being uniform. In sample No. 1, the results differed by 0.003 per cent. of nitrogen; in sample No. 2

by 0.004 per cent. of nitrogen, the excess being first with one method and then with the other.

Second. That the individual results obtained by several determinations of the same milk agree closely by either method, somewhat closer accordance being given by precipitation at 40° C. Thus, in sample No. 1, the greatest difference in three determinations was 0.006 per cent. of nitrogen at 40° C., and 0.025 per cent. nitrogen with the other method. In sample No. 2, the greatest difference was 0.009 per cent. nitrogen at 40° C. in three determinations and 0.011 per cent. nitrogen with the other method.

(2). *Influence of amount of acid used in precipitating casein.*—The acid used was a solution containing ten per cent. by weight of acetic acid. This dilute acetic acid was used in amounts varying from 0.5 to 5 cc. To about ten grams of milk, sufficient water at 40°–42° C. was added to dilute to 100 cc. and the acetic acid was then added. The operation was completed in the manner described above.

Below we present the analytical results tabulated:

	Amount of acid used.	Character of filtrate.	Per cent. of nitrogen found in the precipitate.
	cc.		
Sample No. 1........	0.5	Slightly cloudy	0.458
	1.0	Clear	0.458
	2.0	Clear	0.449
	3.0	Clear	0.441
Sample No. 2.......	1.0	Clear	0.475
	1.5	Clear	0.474
	2.0	Clear	0.469
	3.0	Slightly cloudy	0.450
Sample No. 3........	0.5	Milky	0.117
	1.0	Quite cloudy	0.471
	1.5	Clear	0.545
	2.0	Clear	0.550
	2.5	Clear	0.545
	3.0	Clear	0.537
	4.0	Slightly cloudy	0.527
	5.0	Milky	0.340
Sample No 4........	0.5	Milky	0.059
	1.0	Slightly cloudy	0.551
	1.5	Clear	0.550

Statement of results.— The data presented in the preceding table indicate:

First, that in one sample 0.5 cc. of acid gave a maximum amount of nitrogen in the precipitate, while in two other samples, the amount of nitrogen obtained in the precipitate was very low. In each instance where the lowest results were given, the filtrate was milky in appearance.

Second, that in three samples out of four, the use of 1.0 cc. of acid gave highest results, the filtrate being clear or only faintly cloudy.

Third, that, in most instances, the use of 1.5 cc. of acid gave the highest results, with a clear filtrate in every case.

Fourth, that the use of two cc. of acid gave very nearly the same results as the use of 1.5 cc. of acid in most cases, the filtrate being clear.

Fifth. That the use of 2.5 cc. or more of acid gave lower results, the decrease becoming greater with increase of acid and the character of the filtrate becoming more turbid in appearance.

Sixth. That, with fresh milk, the best results can be secured in determining casein by using from one to two cc. or in general, 1.5 cc. of a ten per cent. solution of acetic acid.

Seventh. That the completeness of precipitation is quite fairly indicated by the character of the filtrate. When the precipitation is incomplete as a result of using too little acid, the filtrate will be more or less turbid, varying from opaque milkiness to barely preceptible cloudiness. If, on the other hand, an excess of acid is used, thereby causing more or less casein to remain in solution, the filtrate will be more or less turbid according to the amount of casein in solution. In some cases, a filter paper may allow some precipitated casein to pass through and render the filtrate turbid. In such cases, two or three repeated filterations generally serve to remove the casein and to give a clear filtrate.

(3.) *The use of different acids in precipitating casein.*— In order to ascertain whether some other acid could be used to precipitate casein more effectively than acetic acid, comparative trials were made with solutions containing ten per cent. of the following acids: (1) acetic, (2) lactic, (3) sulphuric, (4) hydrochloric. Below are given the results of the comparative trials:

KIND OF ACID USED.	Amount of acid used.	Character of filtrate.	Character of precipitate.	Per cent. of nitrogen in precipitate.
Acetic acid	1.5 cc.	Clear	Flocculent	0.395
Lactic acid	0.5 cc.	Milky	Flocculent	0.074
Lactic acid	0.75 cc.	Slightly cloudy	Flocculent	0.396
Lactic acid	1.0 cc.	Clear	Flocculent	0.394
Lactic acid	1.5 cc.	Milky	Flocculent	0.268
Acetic acid	1.5 cc.	Clear	Flocculent	0.465
Sulphuric acid	0.5 cc.	Clear	Somewhat gelatinous.	0.470
Sulphuric acid	0.75 cc.	Clear	Somewhat gelatinous	0.457
Sulphuric acid	1.0 cc.	Cloudy	Somewhat gelatinous.	0.417
Acetic acid	1.5 cc.	Clear	Flocculent	0.464
Hydrochloric acid	0.3 cc.	Cloudy	Gelatinous	0.410
Hydrochloric acid	0.5 cc.	Cloudy	Gelatinous	0.404
Hydrochloric acid	0.75 cc.	Milky	Gelatinous	0.199

Statement of results.— The results contained in the foregoing table show:

First. That lactic acid gives results closely agreeing with those obtained by the use of acetic acid, when about one cc. of a ten per cent. solution of lactic acid is used, but if 0.5 cc. more or less than one cc. of lactic acid are used the results are very low. The precipitate was flocculent and filtered readily.

Second. That a ten per cent. solution of sulphuric acid when used to the extent of 0.5 cc. for ten grams of milk gave results closely agreeing with those given by the use of acetic acid, but that when more than 0.5 cc. were used the results became lower. The filtrate was clear, but the casein did not separate in flocculent condition, having a tendency to become gelatinous. Several filtrations were required to get a clear filtrate, and filtration was slow.

Third. That very unsatisfactory results were given by the use of hydrochloric acid, whatever the amount used. The filtrate was cloudy or milky, the precipitate gelatinous, the filtration extremely slow and the results low.

Fourth. For the most satisfactory results, for the flocculent character of the precipitate, for rapidity of precipitation, filtration, etc., the use of acetic acid had a great advantage over the other acids tried.

(4.) *Influence of temperature and time of digestion on precipitation of casein.*— In making the experiments, the results of which are tabulated below, the temperature and time of digestion were made to vary, all the other conditions being kept uniform.

TEMPERATURE OF DIGESTION.	Time of digestion.	Character of filtrate.	Per cent. of nitrogen in precipitate.
30° C.	5 minutes	Clear	0.448
40° C.	0 minutes	Clear	0.475
40° C.	1 minute	Clear	0.479
40° C.	2 minutes	Clear	0.481
40° C.	3 minutes	Clear	0.471
40° C.	10 minutes	Clear	0.477
40° C.	20 minutes	Clear	0.484
45° C.	0 minutes	Clear	0.468
45° C.	2 minutes	Clear	0.476
45° C.	5 minutes	Clear	0.483

The data presented in the foregoing table shows:

First. That when the precipitate was digested at thirty degrees C. for five minutes the results were lowest.

Second. That when the precipitate was digested at forty degrees C. without standing or with standing one, two, three, ten, or twenty minutes, the results were practically uniform. The greatest difference obtained by digesting different periods of time did not exceed 0.01 per cent. nitrogen.

Third. That, when the precipitate was digested at 45° C. for periods of time varying from a few seconds to five minutes, the results were fairly uniform, the greatest difference being 0.015 per cent. nitrogen. As compared with digestion at 40° C., digestion at 45° C. gave essentially the same results.

Fourth. It would, therefore, seem that a variation of temperature two or three degrees above or below 40° C. and variation of time of digestion after the addition of acetic acid exercises comparatively little influence upon the results. However, in practice, I think it is desirable to adhere quite closely to uniformity of temperature.

(5) *The precipitation of casein in the fresh and old milk.*—The fact is well known that milk undergoes rapid and complex changes when left to itself at ordinary temperatures. In the course of our work, it occurred to the writer that, as a result of these changes, the casein might be so changed that the method used in determining casein in fresh milk might not be entirely

applicable to milk that had undergone more or less change; or that the formation of lactic acid might make necessary the use of less acetic acid than is used in precipitating the casein of fresh milk. It was generally found that, after milk had stood at a temperature of 17° to 22° C. for twenty-four hours or more, the use of 1.5 cc. of a ten per cent. solution of acetic acid gave low results, the filtrate being decidedly turbid. In some cases the casein was almost entirely rendered soluble and passed into the filtrate. It was found that the only method of handling milk under such circumstances was to add the acetic acid to the milk, diluted with water at 40°–42° C., in small portions of a few drops at a time, stirring after each addition and continuing the additions until the liquid above the precipitate became clear or nearly so. But even with this treatment, there was found to be more or less loss. The terms "fresh" and "old" milk are, of necessity, rather vague. Much depends upon the conditions under which milk is kept. The extent of change rather than the actual age of the milk should form the basis of distinction. Coagulated milk gave low results.

	Age of milk.	Per cent. of nitrogen in precipitate.	Amount of loss.
Sample No. 1..........	Fresh	0.429	....
	Seven days.........	0.378	0.051
Sample No. 2..........	Fresh	0.447	....
	One day...........	0.427	0.020
	Three days.........	0.428	0.019
	Seven days.........	0.428	0.019
Sample No. 3..........	Fresh	0.428	....
	One day...........	0.410	0.018
Sample No. 4..........	Fresh	0.438	....
	One day..........	0.415	0.023
Sample No. 5..........	Fresh	0.624	....
	One day...........	0.617	0.007
Sample No. 6..........	Fresh	0.397	....
	One day...........	0.397	0.000
Sample No. 7..........	Fresh	0.466	....
	One day...........	0.445	0.021

The author has in progress an investigation relating to the detailed changes that take place in the nitrogen compounds of milk under various conditions.

Statement of results.— First, when milk was kept at a temperature of 17° to 22° C. for twenty-four hours, the amount of nitrogen as casein was found, in most cases, to be nearly 0.02 per cent. less than in fresh milk.

Second. In case of one milk kept seven days, the amount of nitrogen in the casein was 0.051 per cent. less than in fresh milk, while, in another case, it was 0.019 per cent. less.

Third. In general, it was found necessary, in order to get results that were at all satisfactory, to use less than 1.5 cc. of dilute acetic acid to precipitate the casein in milk that had been standing long enough to undergo any marked change.

Fourth. While good results may, in exceptional cases, be secured in determining casein in milk that has undergone noticeable change without any modification of the method given for the determination of casein in fresh milk, the accuracy of such determinations must be regarded as uncertain in regular work.

(6) *The influence of mercuric chloride used as a preservative on the determination of casein in milk.*— In view of what has just preceded, can we be certain of our results when we determine casein in milk that is not fresh? The thought suggested itself to the author that if some germicide could be added to fresh milk to prevent or retard the changes that affect the casein, then we might be able to determine the casein in milk that had stood indefinitely. In order to test the question, finely powdered mercuric chloride was used in proportion of about one part of mercuric chloride to 2,000 parts of milk by weight. A sample of milk was analyzed when fresh, and portions were set aside for varying periods of time, some with and some without the addition of mercuric chloride. Determinations of casein were made from time to time, using less than 1.5 cc. dilute acetic acid. The results were as follows:

AGE OF MILK.	Per cent. of nitrogen in precipitate when no mercuric chloride was used.	Amount of loss.	Per cent. of nitrogen in precipitate when mercuric chloride was used.	Amount of loss.
Fresh	0.447	......	0.447	....
1 day	0.427	0.20	0.444	0.003
3 days	0.428	0.19	0.444	0.003

Statement of results.— The foregoing results appear to indicate:

First. That the use of mercuric chloride in fresh milk largely prevents or retards the occurrence of those changes that effect the determination of casein.

Second. That even when mercuric chloride is used in milk, it is generally desirable to use less than 1.5 cc. of dilute acetic acid in precipitating the casein.

Third. That the use of mercuric chloride in the proportions stated did not precipitate in appreciable quantity any nitrogen compounds such as albumen.

(7) *General summary.*— We may summarize the results of our work as follows:

First. Precipitation of casein in cows' milk gives essentially the same results whether made at forty degrees C. without carbon dioxide or at ordinary temperatures with the aid of carbon dioxide, other conditions being uniform.

Second. Between one and two cc. of a ten per cent. solution of acetic acid, generally about 1.5 cc., gave the best results.

Third. The use of lactic acid, sulphuric acid, and hydrochloric acid gave results much less satisfactory than the use of acetic acid.

Fourth. A variation of a few degrees from 40° C. and a variation of time of digestion after the addition of acetic acid exercised comparatively little influence on the results.

Fifth. The precipitation of casein in milk that had undergone noticeable change was generally found to give lower results than in case of the same milk when fresh, even when less than 1.5 cc. of acetic acid were used. Coagulated milk always gave low results compared with fresh milk.

Sixth. The use of mercuric chloride in fresh milk, in the proportion of one part of the former to 2,000 parts of milk, largely prevented or retarded the occurrence of those changes that affect the determination of casein in old milk.

Seventh. In a general way, the character of the filtrate serves as a fairly reliable guide in regard to the completeness of the precipitation of casein from milk. When the filtrate is clear or only perceptibly cloudy, the precipitation is generally complete; but, when the filtrate is decidedly turbid or milky and two or three repeated filtrations do not remove the turbidity, the precipitation will generally be found incomplete and such a determination, if carried out, will give low results.

(8) *Detailed description of method used in determining the casein of cows' milk.*—I. In fresh milk: Weigh out about ten grams of milk, dilute in a beaker with about ninety cc. of water at 40°–42° C., and add at once 1.5 cc. of a solution containing ten per cent. of acetic acid by weight. Stir with a glass rod and let stand three to five minutes or longer. Then decant on filter, wash two or three times with cold water by decantation, and then transfer precipitate completely to filter. Wash once or twice on filter. The filtrate should be clear or very nearly so. If the filtrate is not clear when it first runs through, it can generally be made so by two or three repeated filtrations, after which the washing of the precipitate can be completed. The washed precipitate and filter paper are then digested as in the regular Kjeldahl method for the determination of nitrogen and the determination of nitrogen is completed as usual. To calculate the nitrogen into an equivalent amount of casein, multiply the amount of nitrogen found by the factor 6.25. Ordinarily, for this purpose, milk can be regarded as "fresh" when it does not show marked development of lactic acid.

II. In old milk: When milk has undergone such change as to show marked development of lactic acid, the method above given can not generally be relied upon to give accurate results in determining casein. So far as our results go, they indicate that we can not with positive accuracy determine casein in such milk by any method now known, and results obtained with changed milk must be regarded as only approximate If, however, one part of finely powdered mercuric chloride is added to 2,000 parts of milk, when fresh, the changes, which would otherwise take place, are prevented or greatly retarded, so that milk treated in this manner may be used after standing some days for the determination of its casein. In such cases, the method given above for fresh milk may be followed, except that the acetic acid should be added in small portions, a few drops at a time, stirring after each addition, and continuing the addition of acetic acid until the liquid above the precipitate becomes clear or very nearly so.

XIX. TRADE VALUES OF FERTILIZING INGREDIENTS IN RAW MATERIALS AND CHEMICALS, ADOPTED BY EXPERIMENT STATIONS.

	1892. Cts. per pound.	1893. Cts. per pound.
Nitrogen in ammonia salts	17½	17
Nitrogen in nitrates	15	15½
Organic nitrogen in dry and fine ground fish, meat and blood, and in high grade mixed fertilizers	16	17½
Organic nitrogen in cotton-seed meal and castor pomace	15	16½
Organic nitrogen in fine ground bone and tankage	15	15
Organic nitrogen in fine ground medium bone and tankage	12	12
Organic nitrogen in medium bone and tankage	9½	9
Organic nitrogen in coarse bone and tankage	7½	7
Organic nitrogen in hair, horn shavings and coarse fish scraps	7	7
Phosphoric acid, soluble in water	7½	6½
Phosphoric acid, soluble in ammonium citrate	7½	6
Phosphoric acid in fine bone and tankage	7	6
Phosphoric acid in fine medium bone and tankage	5½	5
Phosphoric acid in medium bone and tankage	4½	4
Phosphoric acid in coarse bone and tankage	3	3
Phosphoric acid in fine ground fish, cotton-seed meal, castor pomace and wood ashes	5	5
Phosphoric acid in fine ground rock phosphate	2	2
Potash as high-grade sulphate, in forms free from muriates (chlorides) in ashes, etc	5½	5½
Potash in kainit	4½	4½
Potash in muriate	4½	4½
Organic nitrogen in mixed fertilizers	17	17½
Insoluble phosphoric acid in mixed fertilizers	2	2

Valuation of Fertilizing Ingredients in Foods.

Organic nitrogen	17½
Phosphoric acid	5
Potash	5½

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILI-

Composition of fertilizers as guaranteed by manufacturers, and

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Acme Fertilizer Co., Maspeth, L. I.	Acme fertilizer No. 1.	Flatbush. Jamaica.	1003 1038
Acme Fertilizer Co., Maspeth, L. I.	Acme fertilizer No. 2.	Flatlands. Jamaica.	1000 1039
Acme Fertilizer Co., Maspeth, L. I.	Lion Acme E brand.	Florida.	1073
Acme Fertilizer Co., Maspeth, L. I.	Superior superphosphate.	Florida.	1072
H. J. Baker & Co., 215 Pearl st., New York city.	Complete cabbage manure.	Parkville.	995
H. J. Baker & Co., 215 Pearl st., New York city.	Complete potato manure.	Gravesend. Jamaica.	998 1041
Baltimore Guano Co., Baltimore, Md.	Baltimore special.	Cato.	1136
Baltimore Guano Co., Baltimore, Md.	B. G. ammoniated bone.	Cato.	1137
Baltimore Guano Co., Baltimore, Md.	Defiance potato manure.	Cato.	1138
Baltimore Guano Co., Baltimore, Md.	Game guano.	Cato.	1139
Bowker Fertilizer Co., Boston and New York.	Ammoniated dissolved bone.	Warsaw.	1227
Bowker Fertilizer Co., Boston and New York.	Carpenter's special fertilizer for peas and beans.	Jamaica.	1022
Bowker Fertilizer Co., Boston and New York.	Hill and drill.	Cato.	1152
Bowker Fertilizer Co., Boston and New York.	Stockbridge manure for potatoes and vegetables.	Jamaica.	1021
Bowker Fertilizer Co., Boston and New York.	Sure crop.	Cato.	1153

ZERS IN NEW YORK STATE FOR THE SPRING OF 1893.

as found by chemical analysis. Expressed in parts per hundred.

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	3.7 to 4.1 3.03	4.5 to 5 3.68	8 to 9 7.5	.... 1.25	.... 8.75	9 to 10 7.66
Guaranteed. Found.	4.95 to 5.35 4.15	6 to 6.5 5.03	8 to 9 8.47	.... 1.59	.... 10.06	5 to 6 5.35
Guaranteed. Found.	2.5 to 3.3 2.29	3 to 4 2.78	7 to 8 6.91	.... 1.95	.... 8.86	3.7 to 4.3 4.41
Guaranteed. Found.	1.25 to 2.5 1.54	1.5 to 3 1.87	8 to 10 6.9	.... 1.96	.... 8.86	4 to 5 4.37
Guaranteed. Found.	4.7 4.52	5.75 5.48	5 6	.... 1.71	.... 7.71	7 7.79
Guaranteed. Found.	3.3 3.6	4 4.37	5.75 5.99	.... 1.32	.... 7.31	10 11.71
Guaranteed. Found.	0.83 to 1.65 1.03	1 to 2 1.25	9 to 11 8.99	2 1.65	11 to 13 10.64	2 to 3 2.17
Guaranteed. Found.	1.25 to 2.05 1.37	1.5 to 2.5 1.66	8 to 10 7.83	2 to 3 1.86	10 to 13 9.69	2 to 3 2.59
Guaranteed. Found.	0.83 to 1 65 1.3	1 to 2 1.58	8 to 10 8.28	2 1.42	10 to 12 9.7	4.3 to 5.4 3.65
Guaranteed. Found.	2.05 to 2.9 2.29	2.5 to 3.5 2.78	9 to 11 8.73	2 to 3 1.45	11 to 13 10.18	2.5 to 3.5 2.95
Guaranteed. Found.	1.65 to 2.5 1.78	2 to 3 2.16	8 to 10 8.6	2 1.1	10 to 12 9.7	2 to 3 3.16
Guaranteed. Found.	2.5 to 3.3 2.56	3 to 4 3.11	10 to 12 9.61	.... 2.1	.... 11.71	2 to 2.25 6.87
Guaranteed. Found.	2 to 3 1.69	2.4 to 3.6 2.05	8 to 10 8.58	2 4.47	10 to 12 13.05	2 to 3 2.09
Guaranteed. Found.	3.3 to 4.1 3.5	4 to 5 4.24	5 to 7 9.2	2 2.04	7 to 9 11.24	7 to 9 7
Guaranteed. Found.	0.83 to 1.65 0.75	1 to 2 0.9	8 to 10 9.64	2 2.4	10 to 12 12.04	1 to 2 1.3

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bowker Fertilizer Co., Boston and New York.	Tecumseh bone phosphate.	Warsaw.	1224
Bradley Fertilizer Co , Boston, Mass.	Ammoniated dissolved bone.	Oneida.	1094
Bradley Fertilizer Co , Boston, Mass.	B. D. Sea fowl guano.	Omro.	1120
Bradley Fertilizer Co., Boston, Mass.	Circle brand — extra fine ground bone with potash.	Attica.	1216
Bradley Fertilizer Co., Boston, Mass.	Complete manure for potatoes and vegetables.	Flatlands. Jamaica.	999 1020
Bradley Fertilizer Co., Boston, Mass.	Fine ground bone.	Attica.	1215
Bradley Fertilizer Co., Boston, Mass.	Farmers' new method.	Chester.	1058
Bradley Fertilizer Co., Boston, Mass.	Justice dissolved bone.	Warsaw.	1233
Bradley Fertilizer Co., Boston, Mass.	Niagara phosphate.	Oneida.	1093
Bradley Fertilizer Co., Boston, Mass.	Potato fertilizer.	Chester.	1060
Bradley Fertilizer Co., Boston, Mass.	Patent superphosphate.	Chester.	1059
Brown & Gilmore, Philadelphia, Pa.	Special cabbage manure.	Canarsie.	1005
Chemical Co. of Canton, Baltimore, Md.	Gem acid phosphate.	Albion.	1196
Chemical Co of Canton, Baltimore, Md.	Soluble bone and potash.	Albion.	1197
Clark's Cove Fertilizer Co., New Bedford, Mass	Bay State fertilizer.	Altamont.	1082
Clark's Cove Fertilizer Co., New Bedford, Mass	Great Planet "A" manure.	Queens.	1035

NEW YORK STATE FOR THE SPRING OF 1893 — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia	Available.	Insoluble.	Total.	
Guaranteed.	....	....	7 to 9	....	9 to 11	....
Found.	....	....	13.5	1.37	14.87	....
Guaranteed.	1.65 to 2.5	2 to 3	7 to 9	1	8 to 10	1 to 2
Found.	2.17	2.63	9.7	1.18	10.88	1.42
Guaranteed.	2.05 to 2.9	2.5 to 3.5	8 to 10	2	10 to 12	1.5 to 2.5
Found.	2.45	2.97	9.96	1.22	11.18	1.44
Guaranteed.	1.85 to 2.7	2.25 to 3.25	....	....	8 to 12	2 to 3
Found.	1.98	2.4	8.77	3.91	12.68	2.35
Guaranteed.	3.7 to 4.1	4.5 to 5	8.5 to 10	1.5 to 2	10 to 12	7 to 8
Found.	3.67	4.45	8.7	0.71	9.41	6.78
Guaranteed.	2.5 to 3.3	3 to 4	....	....	21 to 23	....
Found.	3.73	4.52	15.11	6.09	21.2	....
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	2	10 to 12	2.1 to 3.25
Found.	1.02	1.24	8.59	1.93	10.52	2.15
Guaranteed.	....	....	12 to 15	1 to 2	13 to 16	....
Found.	....	....	13.74	1.97	15.71	....
Guaranteed.	0.83 to 1.65	1 to 2	7 to 9	1	8 to 10	1.1 to 1.6
Found.	1.11	1.35	8.4	1.51	9.91	2.42
Guaranteed.	2.05 to 2.9	2.5 to 3.5	9 to 10	1 to 2	11 to 12	3.25 to 4.3
Found.	2.09	2.54	8.91	4.87	13.78	3.2
Guaranteed.	2.05 to 2.9	2.5 to 3.5	8 to 10	2	10 to 12	1.5 to 2.5
Found.	2.32	2.82	8.86	1.95	10.81	1.57
Guaranteed.	2.5 to 3.3	3 to 4	6 to 8	....	....	4 to 6
Found.	2.57	3.12	7.49	3.36	10.85	4.29
Guaranteed.	....	....	12 to 14	....	....	....
Found.	....	....	12 57	1.2	13.77	....
Guaranteed.	....	....	10 to 12	2	12 to 14	2 to 3
Found.	....	....	9.65	1.14	10.79	1.77
Guaranteed.	2.5 to 3.3	3 to 4	8 to 11	1.5 to 3	9.5 to 14	2 to 3
Found.	2.71	3.29	9.68	1.62	11.3	1.93
Guaranteed.	3.7 to 4.1	4.5 to 5	7.5 to 9.5	1 to 2	8.5 to 11.5	7.5 to 10
Found.	3.81	4.62	7.53	2.87	10.4	7.62

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Clark's Cove Fertilizer Co., New Bedford, Mass.	King Philip alkaline bone.	Altamont.	1081
Clark's Cove Fertilizer Co., New Bedford, Mass.	Riverhead Club formula.	Riverhead.	1045
Clark's Cove Fertilizer Co., New Bedford, Mass.	Triumph bone and potash.	Altamont.	1080
Coe, E. Frank, New York city.	Gold brand excelsior guano.	Riverhead.	1047
Coe, E. Frank, New York city.	High grade potato fertilizer.	Lyons.	1168
Coe, E. Frank, New York city.	Red brand excelsior guano.	Riverhead. Florida.	1046 1069
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated bone superphosphate	Moravia.	1116
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated wheat and corn phosphate.	Jamaica.	1019
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Ammoniated practical superphosphate.	Moravia. Holley.	1119 1178
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Crocker's phosphate.	Holley.	1179
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Lawn and grass fertilizer.	Jamaica.	1017
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	New rival ammoniated superphosphate.	Moravia. Chester.	1118 1056
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Niagara phosphate.	Warsaw.	1229
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Potato, hop and tobacco phosphate.	Jamaica. Chester.	1018 1057
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Special potato manure.	Lyons.	1159
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Vegetable bone superphosphate.	Mt. Morris.	1234

New York State for the Spring of 1893 — (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed.	1.25 to 1.65	1.5 to 2	6 to 9	1 to 2	7 to 11	3 to 4
Found.	1.5	1.82	7.44	3.06	10.5	3.29
Guaranteed.	4.1 to 4.95	5 to 6	8 to 11	1 to 2	9 to 13	10 to 12
Found.	4.82	5.85	8.4	2.32	10.72	9.79
Guaranteed.	....	....	10 to 12	....	....	2 to 3
Found.	....	....	9 38	2.87	12.25	2.02
Guaranteed.	2.5 to 3.3	3 to 4	8 to 10	....	....	6 to 8
Found.	2.4	2.91	9	2.26	11.26	5.05
Guaranteed.	2.05 to 2.5	2.5 to 3	8 to 10	2 to 3	10 to 12	6
Found.	2.03	2.46	8.85	1 8	10.65	5.34
Guaranteed.	3.3 to 4.1	4 to 5	10 to 12	1 to 2	11 to 14	6 to 7
Found.	3.14	3.81	9.14	0.34	9.48	6.18
Guaranteed.	2.9 to 3.7	3.5 to 4.5	10 to 12	1 to 2	11 to 14	1.1 to 1.6
Found.	3.04	3.69	9.59	1.18	10.77	1.3
Guaranteed.	2 to 3	2.45 to 3.65	10 to 13	1 to 2	11 to 15	1.6 to 2.7
Found.	2.28	2.77	9.59	1.11	10.7	2.06
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	1 to 2	9 to 12	1.1 to 1.6
Found.	1.17	1.42	8.38	1.14	9.52	1.57
Guaranteed.	1.25 to 2.5	1.5 to 3	10 to 13	1 to 3	11 to 15	1.6 to 2.7
Found.	1.54	1.87	9.95	1.12	11.07	1.97
Guaranteed.	1.25 to 2.5	1.5 to 2.5	10 to 12	1 to 3	11 to 15	1.6 to 3
Found.	1.42	1.72	10.59	1.5	12.09	2.19
Guaranteed.	1.25 to 2.05	1.5 to 2.5	10 to 12	1 to 2	11 to 14	1.6 to 2.7
Found.	1.41	1.71	10.66	0.84	11.5	2.21
Guaranteed.	....	....	11.5 to 13	1 to 3	12.5 to 16	....
Found.	....	....	10.92	2.63	13.55	....
Guaranteed.	2 to 3	2.45 to 3.65	10 to 12	1 to 2	11 to 14	3.2 to 4.8
Found.	2.04	2.48	9.90	0.85	10.75	4
Guaranteed.	3.7 to 4.5	4.5 to 5.5	8 to 9	1 to 2	9 to 11	5.4 to 6.7
Found.	3.56	4.32	7.9	0.46	8.36	7.41
Guaranteed.	4.95 to 5 75	6 to 7	6 to 7	1 to 2	7 to 9	6 to 8
Found.	5	6.07	6.07	0.47	6.52	7.55

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Crocker Fertilizer and Chemical Co., Buffalo, N. Y.	Wheat and corn phosphate.	Moravia.	1117
Cumberland Bone Phosphate Co., Portland, Me.	Cumberland phosphate.	New Hope.	1124
Cumberland Bone Phosphate Co., Portland, Me.	Dissolved bone phosphate.	New Hope.	1123
Cumberland Phosphate Co, Portland, Me.	Seeding down.	New Hope.	1122
Darling Fertilizer Co, Pawtucket, R. I.	Animal fertilizer.	Chester.	1079
Ellis, J. J., Darien Center, N. Y.	Reliance phosphate.	Darien Center.	1208
Ellsworth, Tuthill & Co., Promised Land, L. I.	No. 2 fertilizer.	Aquebogue.	1055
Ellsworth, Tuthill & Co., Promised Land, L. I.	Special potato fertilizer.	Aquebogue.	1054
Farmers' Fertilizer Co, Syracuse, N. Y.	Farmers' soluble bone.	Attica.	1210
Farmers' Fertilizer Co., Syracuse, N. Y.	Phœnix brand.	Lyons.	1166
Farmers' Fertilizer Co., Syracuse, N. Y.	Reaper brand.	Chester.	1061
Farmers' Fertilizer Co., Syracuse, N. Y.	Standard special formula.	Lyons.	1167
Forest City Wood Ash Co., London, Can.	Canada hard-wood ashes.	Syracuse.	1101
George B Forester, New York city.	Complete manure for potatoes.	Gravesend.	996
Great Eastern Fertilizer Co., Rutland, Vt.	Bone and potash.	Holley.	1186
Great Eastern Fertilizer Co., Rutland, Vt.	Grain and grass fertilizer.	Holley.	1184
Great Eastern Fertilizer Co., Rutland, Vt.	Garden special.	Hollis.	1028

NEW YORK STATE FOR THE SPRING OF 1893 — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed.	2.05 to 2.9	2.5 to 3.5	10 to 13	1 to 2	11 to 15	1.6 to 2.7
Found.	2.33	2.83	9.2	1.45	10.65	2.05
Guaranteed.	1 to 1.85	1.25 to 2.25	8 to 11	1 to 2	10 to 12	2 to 3
Found.	1.24	1.5	8.36	1.19	9.55	2.15
Guaranteed.	....	....	12 to 15	1 to 2	13 to 16	....
Found.	....	....	12.97	1.93	14.9	....
Guaranteed.	1.65 to 2.5	2 to 3	5 to 6	5 to 6	10 to 12	1 to 2
Found.	1.52	1.85	8.29	1.39	9.68	2.5
Guaranteed.	3.3 to 4.95	4 to 6	7 to 9	....	....	9 to 11
Found.	2.75	3.34	5.59	5.1	10.69	4.82
Guaranteed.	1.25 to 2.05	1.5 to 2.5	8 to 13	....	....	1.6 to 2.7
Found.	1.53	1.86	10.65	1.97	12.62	2.29
Guaranteed.	4.1	5	4	....	....	7
Found.	4.54	5.51	4.16	0.8	4.96	6.87
Guaranteed.	4.1	5	8	....	....	10
Found.	4.93	5.98	7.77	0.76	8.53	11.47
Guaranteed.	....	....	6 to 7.5	1 to 2	7.5 to 9	2.15 to 2.6
Found.	....	....	6.5	0.35	6.85	1.86
Guaranteed.	1.25 to 2.05	1.5 to 2.5	5 to 7	1 to 2	6 to 8	1.6 to 2.7
Found.	1.07	1.3	6.26	0.24	6.5	2.01
Guaranteed.	1.65 to 2.5	2 to 3	5.5 to 7	2	7.5 to 9	4.3 to 5.4
Found.	1.33	1.61	6.75	0.28	7.03	4.22
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	2	10 to 12	2.15 to 3.25
Found.	0.72	0.87	7.42	0.33	7.75	1.93
Guaranteed.	....	....	....	....	....	5 to 7
Found.	....	....	1.23	0.6	1.83	5.95
Guaranteed.	3.7	4.5	5.5	....	....	10
Found.	4.74	5.75	6.27	....	6.27	10.95
Guaranteed.	....	....	10 to 12	....	....	2.15 to 3.25
Found.	....	....	10.33	0.5	10.83	1.78
Guaranteed.	2.5 to 3.3	3 to 4	8 to 12	1 to 3	9 to 15	2 to 4
Found.	2.5	3	8.16	1.04	9.2	2.27
Guaranteed.	3.3 to 4.1	4 to 5	6 to 8	....	....	8 to 10
Found.	3	3.64	6.64	0.68	7.32	8.36

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Great Eastern Fertilizer Co., Rutland, Vt.	Oats, buckwheat and seeding-down phosphate.	Holley.	1182
Great Eastern Fertilizer Co., Rutland, Vt.	Vegetable, vine and tobacco grower.	Chester.	1064
Great Eastern Fertilizer Co., Rutland, Vt	Wheat special.	Lyons. Holley.	1162 1185
Griffing & Tuthill, Riverhead, L. I.	G. & T. high-grade potato manure.	Riverhead.	1048
Hallock & Duryee, Mattituck, L. I.	Cutchogue Club fertilizer.	Mattituck.	1236
Hallock & Duryee, Mattituck, L. I.	Lupton's potato fertilizer.	Mattituck.	1237
Hallock & Duryee, Mattituck, L. I.	Mattituck fertilizer.	Mattituck.	1239
Hallock & Duryee, Mattituck, L. I.	No. 1 fertilizer.	Mattituck.	1238
Hallock & Duryee, Mattituck, L. I.	No. 2 cabbage fertilizer.	Mattituck.	1240
Hendrickson, Isaac C., Jamaica, L. I.	High grade potato fertilizer.	Jamaica.	1011
Hendrickson, Isaac C., Jamaica, L. I.	L. I. cabbage fertilizer	Jamaica.	1012
Hess, S. M. & Bro., Philadelphia, Pa.	Ammoniated bone superphosphate.	Mattituck.	1049
Hess, S. M. & Bro., Philadelphia. Pa.	Bone meal.	Mattituck.	1053
Hess, S. M. & Bro., Philadelphia, Pa.	Keystone dissolved bone phosphate.	Mattituck.	1052
Hess, S. M. & Bro., Philadelphia, Pa.	Potato and truck manure.	Mattituck.	1050
Imperial Guano Co., Norfolk, Va.	Imperial guano.	Jamaica.	1044

NEW YORK STATE FOR THE SPRING OF 1893 — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed.	0.83 to 1.65	1 to 2	8 to 12	1 to 3	9 to 15	4 to 6
Found.	1.1	1.33	8.15	1.18	9.33	4.08
Guaranteed.	2.05 to 2.9	2.5 to 3.5	8 to 12	1 to 3	9 to 15	3.25 to 4.3
Found.	2.05	2.5	8.35	0.53	8 88	3.47
Guaranteed.	1.65 to 2.5	2 to 3	8 to 12	1 to 3	9 to 15	1.6 to 2.7
Found.	1.81	2.2	8.39	0.6	8.99	2.18
Guaranteed.	3.3 to 4.1	4 to 5	7 to 9	2	9 to 11	7 to 9
Found.	3.32	4.03	8.68	1.27	9.95	7.4
Guaranteed.	4.1	5	8	....	....	10
Found.	3.65	4.43	7.81	0.97	8.78	9.02
Guaranteed.	3.3 to 4.1	4 to 5	7 to 9	....	....	9 to 11
Found.	2.53	3.07	6.28	0.11	6.39	8.95
Guaranteed.	3.3 to 4.1	4 to 5	5 to 7	....	....	7 to 9
Found.	2.64	3.2	4.78	0.15	4.93	6.3
Guaranteed.	3.3 to 4.1	4 to 5	7 to 9	....	....	9 to 11
Found.	2.48	3	6.51	0.61	7.12	9.47
Guaranteed.	4.1 to 4.95	5 to 6	6 to 8	....	....	6 to 8
Found.	4.02	4.88	6.97	0.1	7.07	6.43
Guaranteed.	4.1 to 4.95	5 to 6	4 to 7	1 to 2	5 to 9	9 to 10
Found.	3.12	3.79	9.44	0.45	9.89	7.48
Guaranteed.	2.5 to 3.3	3 to 4	6 to 8	....	....	6 to 8
Found.	1.84	2.23	9.16	0.28	9.44	5.82
Guaranteed.	1.65 to 2.9	2 to 3.5	8 to 11	....	....	2 to 3.5
Found.	1.78	2.16	8.61	2.23	10.84	2.01
Guaranteed.	2.5 to 4.1	3 to 5	....	....	15 to 20	....
Found.	2.75	3.34	15.34	8.74	24.08	....
Guaranteed.	0.83 to 1.65	1 to 2	11 to 15	1 to 2	12 to 17	1 to 2
Found.	1.06	1.29	10.5	2.5	13	1.14
Guaranteed.	2.5 to 3.3	3 to 4	8 to 10	....	....	6 to 8
Found.	2.75	3.34	8.7	0.71	9.41	6.14
Guaranteed.	8 to 9	9.7 to 10.9	6 to 7	2 to 3	8 to 10	3.5 to 4.5
Found.	7.77	9.43	8.19	0.56	8.75	5.46

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Imperial Guano Co., Norfolk, Va.	Imperial 8 per cent guano for potatoes.	Jamaica.	1043
Lackawanna Fertilizer and Chemical Co., Moosic, Pa.	Bone superphosphate for corn, wheat and rye.	Gasport.	1199
Lackawanna Fertilizer and Chemical Co., Moosic, Pa.	Moosic phosphate.	Gasport.	1198
Lackawanna Fertilizer and Chemical Co., Moosic, Pa.	Pure ground bone.	Gasport.	1200
Lackawanna Fertilizer and Chemical Co., Moosic, Pa.	Special manure for potatoes, tobacco and hops.	Gasport.	1201
Liebig Manufacturing Co., Carteret, N. J.	Ammoniated dissolved bone.	Moravia.	994
Liebig Manufacturing Co., Carteret, N. J.	Ammoniated superphosphate for potatoes and corn.	Moravia.	992
Liebig Manufacturing Co., Carteret, N. J.	Dissolved bone	Moravia.	991
Liebig Manufacturing Co., Carteret, N. J.	Dissolved bone and potash.	Moravia.	990
Liebig Manufacturing Co., Carteret, N. J.	Standard phosphate.	Moravia.	993
Lister Agricultural and Chemical Works, Newark, N. J.	Ammoniated dissolved bone phosphate.	Moravia.	1103
Lister Agricultural and Chemical Works, Newark, N. J.	Cauliflower and cabbage manure.	Gravesend. Jamaica.	1002 1010
Lister Agricultural and Chemical Works, Newark, N. J.	Celebrated ground bone.	Altamont.	1088
Lister Agricultural and Chemical Works, Newark, N. J.	Potato fertilizer No. 2.	Altamont.	1087
Lister Agricultural and Chemical Works, Newark, N. J.	Potato manure.	Gravesend. Jamaica.	1001 1009

NEW YORK STATE FOR THE SPRING OF 1893 — (*Continued*).

	NITROGEN		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	6.6 to 7.4 6.43	8 to 9 7.81	7 to 8 7.22	2 to 3 0.79	9 to 12 8.01	7 to 8 8.94
Guaranteed. Found.	1.65 to 2.5 1.5	2 to 3 1.82	10 to 12 6.25	1 to 2 1.98	11 to 14 8.23	2 to 3 3.10
Guaranteed. Found.	1.25 to 1 65 1.02	1 5 to 2 1.24	6 to 8 4	1 to 2 2.23	7 to 10 6.23	1.5 to 2 2.14
Guaranteed. Found.	3.3 to 3.7 4	4 to 4.5 4.85	.... 19.25	.... 2.59	21 to 22 21.84	....
Guaranteed. Found.	2.5 to 3.3 2.43	3 to 4 2.95	10 to 12 8.34	1 to 2 2.76	11 to 14 11.1	6 to 7 6.85
Guaranteed. Found.	2.05 to 2.9 2.08	2.5 to 3.5 2.53	10 to 12 10.28	.... 0.7	.... 10.98	2.5 to 3.5 2.74
Guaranteed. Found.	2.9 to 3.3 3.09	3.5 to 4 3.75	6 to 8 8.33	.... 0.49	.... 8.82	7 to 8 7.55
Guaranteed. Found.	....	....	14 to 15.5 14.01	.... 0.42	.... 14.43	....
Guaranteed. Found.	....	....	13 to 15 13.33	.... 0.37	.... 13.7	3 to 4 3.03
Guaranteed. Found.	1.25 to 2.05 1.3	1.5 to 2.5 1.58	10 to 12 10.68	.... 0.8	.... 11.48	2.5 to 3.5 2.46
Guaranteed Found.	1.8 to 2.05 1.95	2.2 to 2.5 2.37	9 to 10 9.04	2 to 3 3.05	11 to 13 12.09	1.5 to 2 1.99
Guaranteed. Found.	3.7 to 4.1 3.82	4.5 to 5 4.63	7.5 to 9 8.06	.... 0.87	.... 8.93	7 to 8 7.37
Guaranteed. Found.	2.7 to 2.9 3.83	3.25 to 3.5 4.64	.... 8.32	.... 4.72	12 to 14 13.04	....
Guaranteed. Found.	1.8 to 2.5 2.35	2.2 to 3 2.85	9.25 to 11 9.5	.... 2.13	.... 11.63	4 to 5 3.28
Guaranteed. Found.	3.7 to 4.1 3.64	4.5 to 5 4.41	7.5 to 9 8.11	.... 0.76	.... 8.87	7 to 8 7.16

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Lister Agricultural and Chemical Works, Newark, N. J.	Success.	Altamont.	1086
Lister Agricultural and Chemical Works. Newark, N. J.	Standard pure bone superphosphate of lime.	Jamaica.	1008
Lorentz & Rittler, Baltimore, Md.	Farmers' alkaline bone.	Albion.	1194
Ludlam, Frederick, New York city.	A. B. F. brand.	Moravia.	1133
Ludlam, Frederick, New York city.	Cereal brand.	Moravia.	1134
Ludlam, Frederick, New York city.	Dragon's tooth brand.	Moravia.	1132
Ludlam, Frederick, New York city.	Sickle brand.	Moravia.	1135
Mapes Formula and Peruvian Guano Co., New York city.	Cabbage and cauliflower manure.	Jamaica.	1025
Mapes Formula and Peruvian Guano Co., New York city.	Complete manure "A" brand.	Moravia.	1111
Mapes Formula and Peruvian Guano Co., New York city.	Complete manure for light soils.	Chester.	1063
Mapes Formula and Peruvian Guano Co., New York city.	Complete vegetable manure.	Jamaica.	1023
Mapes Formula and Peruvian Guano Co., New York city.	Potato manure.	Moravia.	1110
Mapes Formula and Peruvian Guano Co., New York city.	Potato manure — L I special.	Jamaica.	1024
Maples Formula and Peruvian Guano Co., New York city.	XXV phosphate.	Moravia.	1112
Maryland Fertilizer and Manufacturing Co., Baltimore, M. D.	Alkaline bone.	Venice. Holley.	1126 1173
Maryland Fertilizer and Manufacturing Co., Baltimore, Md.	A. E. fertilizer.	Venice.	1127

New York State for the Spring of 1893 — (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	1.25 to 1.65 1.49	1.5 to 2 1.81	9.5 to 11 9.32	.... 2.26	.... 11.58	1.5 to 2 1.85
Guaranteed. Found.	2.35 to 2.70 2.45	2.85 to 3.25 2.97	10 to 12 10.23	2 to 3 1.63	.... 11.86	1.5 to 2 1.77
Guaranteed. Found.	....	....	10 to 12 10.36	2 to 3 1.26	12 to 15 11.62	1.5 to 2 1.81
Guaranteed. Found.	1.65 to 2.5 1.92	2 to 3 2.33	8 to 10 7.92	2 2.66	10 to 12 10.58	2 to 3 2.39
Guaranteed. Found.	0.83 to 1.65 0.8	1 to 2 0.97	8 to 10 10	2 2.21	10 to 12 12.21	1 to 2 1.05
Guaranteed. Found.	3.3 to 4.1 2.63	4 to 5 3.19	7 to 9 8 77	.... 2 54	.... 11.31	7 to 9 7.51
Guaranteed. Found.	....	....	10 to 12 12.47	2 0.86	12 to 14 13.33	1 to 2 1.16
Guaranteed. Found.	4.1 to 4 95 4.13	5 to 6 5.01	6 7.81	.... 0.24	6 to 8 8.05	6 to 8 6.57
Guaranteed. Found.	2.5 to 3.3 2.87	3 to 4 3.48	10 to 12 11.74	2 to 4 0.41	12 to 16 12.15	2.5 to 3.5 3.59
Guaranteed. Found.	4.95 to 6.6 4.82	6 to 8 5.85	6 to 8 7.98	2 1.02	8 to 10 9	6 to 8 6.86
Guaranteed. Found.	4.95 to 6.6 5.13	6 to 8 6.22	6 to 8 8.54	.... 0.85	8 to 10 9.39	6 to 8 6.6
Guaranteed. Found.	3.7 to 4.1 3.7	4.5 to 5 4.5	8 8.92	.... 0.13	8 9.05	6 to 8 7.19
Guaranteed. Found.	3.3 to 4.1 3.43	4 to 5 4.16	6 to 8 8.31	.... 0.42	.... 8.73	7 to 9 7.6
Guaranteed. Found.	2.05 2.05	2.5 2.5	7 9.61	1 0.1	8 9.71	1 1.23
Guaranteed. Found.	....	....	11 to 15 11.36	1 to 2 0.92	12 to 17 12.28	3 to 4 4.42
Guaranteed. Found	....	....	9 to 10 11.03	2 to 3 1.6	11 to 13 12.63	2.15 to 2.7 2.19

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Maryland Fertilizer and Manufacturing Co., Baltimore, Md.	Barley fertilizer.	Venice.	1128
Maryland Fertilizer and Manufacturing Co., Baltimore, Md.	Globe complete manure.	Venice.	1125
Maryland Fertilizer and Manufacturing Co., Baltimore, Md.	Seneca chief ammoniated dissolved bone.	Lyons.	1157
Michigan Carbon Works, Detroit, Mich.........	Homestead bone black.	Wolcott. Holley.	1143 1181
Michigan Carbon Works, Detroit, Mich.........	Jarves drill phosphate.	Holley.	1180
Milsom Rendering and Fertilizer Co., E. Buffalo, N. Y.	Buffalo fertilizer.	Sodus. Lyons.	1148 1170
Milsom Rendering and Fertilizer Co., E. Buffalo, N. Y.	Buffalo fertilizer.	Attica.	1221
Milsom Rendering and Fertilizer Co., E. Buffalo, N. Y.	Buffalo guano.	Sodus.	1150
Milsom Rendering and Fertilizer Co., E. Buffalo, N. Y.	Erie King.	Sodus.	1149
Milsom Rendering and Fertilizer Co., E. Buffalo, N. Y.	Hop and tobacco phosphate.	Attica.	1219
Milsom Rendering and Fertilizer Co., E. Buffalo, N. Y.	Vegetable bone fertilizer.	Lyons.	1171
Milsom Rendering and Fertilizer Co., E. Buffalo, N. Y.	Vegetable bone fertilizer.	Attica.	1218
Milsom Rendering and Fertilizer Co., E. Buffalo, N. Y.	Wheat oats and barley phosphate.	Sodus.	1151
Milsom Rendering and Fertilizer Co., E. Buffalo, N. Y.	Wheat, oats and barley phosphate.	Attica.	1220
Mitchell Fertilizer Co., Tremley, N. J.	Standard superphosphate.	Holley.	1172
Moller & Co. Bone Works, Maspeth, L. I.	Champion No. 1 pure bone fertilizer.	Jamaica. Canarsie.	1015 1006

NEW YORK STATE FOR THE SPRING OF 1893 — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	....	....	11 to 14 12.82	.... 1.03	.... 13.85	4.5 to 5.5 4.81
Guaranteed. Found.	1.5 to 2.05 1.82	1.75 to 2.5 2.21	9 to 12 9.42	1 to 2 2.35	10 to 14 11.77	1.5 to 2.25 1.81
Guaranteed. Found.	1.65 to 2.5 1.89	2 to 3 2.29	9 to 12 9.15	.... 2.49	.... 11.64	1.5 to 2 1.98
Guaranteed. Found.	1.85 to 2.6 2.11	2.25 to 3.15 2.56	8 to 11 9.43	.... 1.15	.... 10.58	1.5 to 1.9 1.76
Guaranteed. Found.	1 to 1.65 1.26	1.25 to 2 1.53	8 to 9 7.89	2 to 3 0.72	10 to 12 8.61	0.3 to 0.5 0.23
Guaranteed. Found.	2.5 to 3.8 1.98	3 to 4.65 2.4	8 to 12.3 8.53	2 to 3 1.99	10 to 15.3 10.52	1.5 to 2.5 1.27
Guaranteed. Found.	2.5 to 3.8 1.8	3 to 4.65 2.19	8 to 12.3 7.43	2 to 3 2.04	10 to 15.3 9.83	1.5 to 2.5 1.02
Guaranteed. Found.	0.83 to 1.65 0.94	1 to 2 1.14	10 to 12 7.40	1 to 3 1.19	11 to 15 8.59	1 to 2 1.31
Guaranteed. Found.	0.83 to 1.65 0.69	1 to 2 0.84	8.45 to 10.45 8.3	4 to 5 2.1	12.45 to 15.43 10.4	1.9 to 2.1 2.12
Guaranteed. Found.	2.5 to 3.3 1.89	3 to 4 2.29	8 to 11 8.26	1 to 2 2.11	9 to 13 10.37	5 to 6 2.92
Guaranteed. Found.	4.1 to 4.95 2.69	5 to 6 3.27	3 to 10 9.42	3 to 4 1.82	11 to 14 11.24	5 to 6 3.37
Guaranteed. Found.	4.1 to 4.95 2.92	5 to 6 3.54	8 to 10 7.85	3 to 4 1.6	11 to 14 9.45	5 to 6 3.37
Guaranteed. Found.	1.65 to 3.3 1.1	2 to 4 1.33	8 to 10 5.83	2 to 3 2.7	10 to 13 8.53	2 to 3 1.04
Guaranteed. Found.	1.65 to 3.3 1.38	2 to 4 1.67	8 to 10 6.81	2 to 3 2.78	10 to 13 9.59	2 to 3 1.28
Guaranteed. Found.	1.65 to 2.5 1.33	2 to 3 1.61	9 to 10 12.48	.... 1.33	.... 13.81	2 to 3 1.85
Guaranteed. Found.	4.1 to 4.5 3.38	5 to 5.5 4.1	.... 7.45	.... 1.61	10 to 11 9.06	8 to 9 6.48

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Moller & Co. Bone Works, Maspeth, L. I.	Champion No. 2 pure bone fertilizer.	Jamaica. Canarsie.	1016 1007
National Fertilizer Co., Bridgeport, Conn.	Chittenden's complete fertilizer.	Queens.	1034
Newark Chemical Works, Newark, N. J.	Ammoniated dissolved bone superphosphate.	Moravia.	1108
Newark Chemical Works, Newark, N. J.	Harmony phosphate.	Moravia. Lyons.	1109 1169
Newark Chemical Works, Newark, N. J.	Harvest Queen	Lyons.	1168
Newark Chemical Works, Newark, N. J.	Standard superphosphate of lime.	Moravia.	1107
Northwestern Fertilizer Co., Chicago, Ill.	Horseshoe brand prairie phosphate.	Lyons.	1161
Oakfield Fertilizer Co., Oakfield, N. Y.	Domestic fertilizer.	Holley.	1176
Oakfield Fertilizer Co., Oakfield, N. Y.	Great value fertilizer.	Holley.	1177
Oakfield Fertilizer Co., Oakfield, N. Y.	Potato and tobacco fertilizer.	Holley.	1174
Oakfield Fertilizer Co., Oakfield, N. Y.	Standard fertilizer.	Holley.	1175
Pacific Guano Co., Boston, Mass.	Nobsque guano.	Warsaw.	1228
Phelps, J. E., Jamaica, L. I.	Challenge vegetable fertilizer No. 1.	Jamaica.	1013
Phelps, J. E., Jamaica, L. I.	Challenge vegetable fertilizer No. 2.	Jamaica.	1014
Phillips, Moro, Chemical Co , Philadelphia, Pa.	C and G complete fertilizer.	Moravia.	1105

NEW YORK STATE FOR THE SPRING OF 1893 -- (*Continued.*)

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	4.95 to 5.35 3.6	6 to 6.5 4.37	.... 7.08	.... 2.44	10 to 11 9.52	6.5 to 7 4.92
Guaranteed. Found.	3.3 to 4.1 3.36	4 to 5 4.08	8 to 10 9	2 1.5	10 to 12 10.5	6 to 8 6.66
Guaranteed. Found.	1.8 to 2.5 1.74	2.25 to 3 2.11	9 to 11 8.44	1.5 to 2.5 1.94	10.5 to 13.5 10.38	2.5 to 3 2.47
Guaranteed. Found.	0.83 to 1.65 1.34	1 to 2 1.63	9 to 11 10.15	1 to 2 1.73	10 to 13 11.88	2.5 to 3 2.46
Guaranteed. Found.	1 to 1.65 1.33	1.25 to 2 1.61	10 to 12 9.66	1.5 to 2 1.71	11.5 to 14 11.37	2.5 to 3 2.39
Guaranteed. Found.	2.35 to 2.7 2.39	2.85 to 3.25 2.9	10 to 12 9.01	1.5 to 2.5 2.47	11.5 to 14.5 11.48	2.5 to 3 2.52
Guaranteed. Found.	1.65 to 2.05 1.89	2 to 2.5 2.29	6 to 8 6.84	3 to 4 1.96	9 to 12 8.8	....
Guaranteed. Found.	1.65 to 2.5 1.96	2 to 3 2.38	8 to 10 9.31	1 to 2 0.59	9 to 12 9.9	1.1 to 1.6 1.67
Guaranteed. Found.	0.83 to 1.65 1.15	1 to 2 1.4	6 to 8 7.2	1 to 2 0.46	7 to 8 7.66	1.1 to 1.6 1.5
Guaranteed. Found.	2.5 to 3.3 2.75	3 to 4 3.34	6 to 8 6.57	1 to 2 0.73	7 to 10 7.3	4.3 to 5.4 4.79
Guaranteed. Found.	2.5 to 3.3 2.64	3 to 4 3.2	10 to 12 10.96	1 to 2 0.67	11 to 14 11.63	1.6 to 2.15 2.14
Guaranteed. Found.	1.25 to 1.65 1.18	1.5 to 2 1.43	8 to 12 7.85	1 to 2 1.63	9 to 14 9.48	2 to 3 2
Guaranteed. Found.	4.1 to 4.95 3.15	5 to 6 3.82	4 to 7 6.02	1 to 2 0.47	5 to 9 6.49	9 to 10 8.35
Guaranteed. Found.	3.3 to 4.1 3	4 to 5 3.64	5 to 7 8.01	1 to 2 0.39	6 to 9 8.4	10 to 11 7.77
Guaranteed. Found.	1 to 1.65 0.86	1.25 to 2 1.04	8 to 10 8.7	1 to 2 0.94	9 to 12 9.64	1.25 to 2 1.73

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Phillips, Moro, Chemical Co., Philadelphia, Pa.	Dissolved S. C. phosphate.	Moravia.	1106
Phillips, Moro, Chemical Co., Philadelphia, Pa.	Special potato fertilizer No. 2.	Cato.	1154
Phipps, Wm. W., Albion, N. Y.	Eagle brand ammoniated dissolved bone with potash.	Albion.	1188
Phipps, Wm. W., Albion, N. Y.	Eagle brand dissolved bone.	Albion.	1190
Phipps, Wm. W., Albion, N. Y.	Eagle brand fertilizer for potatoes, corn, fruit and vines.	Albion.	1187
Phipps, Wm. W., Albion, N. Y.	Eagle brand superphosphate with potash.	Albion.	1189
Pottstown Iron Co., Pottstown, Pa.	Odorless phosphate.	Darien Center.	1206
Preston Fertilizer Co., Greenpoint, L. I.	Ammoniated bone superphosphate.	Queens.	1030
Preston Fertilizer Co., Greenpoint, L. I.	Onion fertilizer.	Florida.	1076
Preston Fertilizer Co., Greenpoint, L. I.	Potato fertilizer.	Queens.	1029
Preston Fertilizer Co., Greenpoint, L. I.	Superphosphate No. 2.	Chester.	1062
Quinnipiac Fertilizer Co., New London, Conn.	Ammoniated dissolved bone.	Wolcott.	1142
Quinnipiac Fertilizer Co., New London, Conn.	Climax phosphate.	Florida.	1078
Quinnipiac Fertilizer Co., New London, Conn.	Dissolved bone and potash	Wolcott.	1141
Quinnipiac Fertilizer Co., New London, Conn.	Fish bone and potash.	Attica.	1217

NEW YORK STATE FOR THE SPRING OF 1893 — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	....	....	12 to 14 11.23	.... 0.73	.... 11.96	....
Guaranteed. Found.	1.85 to 2.7 1.5	2.25 to 3.25 1.82	9 to 10 9.41	.... 0.71	.... 10.12	4.75 to 5.75 4.77
Guaranteed. Found.	0.83 to 1.65 0.75	1 to 2 0.9	9 to 11 12.76	2 0.66	11 to 13 13.42	2 to 4 1.77
Guaranteed. Found.	....	....	14.67 14.89	0.83 0.65	15.5 15.44	....
Guaranteed. Found.	2.05 to 2.9 1.6	2.5 to 3.5 1.94	8 to 10 9.76	1 0.54	9 to 11 10.3	7 to 9 6.96
Guaranteed. Found.	....	....	11 to 13 14.38	2 0.63	13 to 15 15.01	2 to 4 1.81
Guaranteed. Found.	....	....	10.3 12.21	9.38 6.74	19.68 18.95	....
Guaranteed. Found.	2.5 to 3.3 3.11	3 to 4 3.78	9 to 11 9.29	.... 1.9	.... 11.19	2 to 3 4.26
Guaranteed. Found.	3.5 to 4.1 3.75	4.25 to 5 4.55	7 to 9 9.54	.... 0.55	.... 10.09	6 to 8 5.7
Guaranteed. Found.	3.3 to 4.1 2.84	4 to 5 3.45	8 to 9 8.93	.... 0.46	.... 9.39	7 to 9 6.83
Guaranteed. Found.	1.25 to 1.65 1.78	1.5 to 2 2.16	8 to 10 9.89	.... 0.45	.... 10.34	2 to 3 1.83
Guaranteed. Found.	1.65 to 2.5 1.74	2 to 3 2.11	9 to 12 9.62	1 to 2 4.01	10 to 14 13.63	2 to 3 2.02
Guaranteed. Found.	1 to 1.65 1.31	1.25 to 2 1.59	8 to 10 8.27	1 to 2 1.95	9 to 12 10.22	2 to 3 1.94
Guaranteed. Found.	....	....	10 to 12 10.09	1 to 2 2.35	11 to 14 12.44	2 to 3 1.92
Guaranteed. Found.	1.65 to 2.5 1.82	2 to 3 2.21	9 to 12 10.43	1 to 2 2.1	10 to 14 12.53	1 to 1.5 1.32

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Quinnipiac Fertilizer Co., New London, Conn.	Market garden manure.	Florida.	1077
Ralston, John, New York city.	Knickerbocker phosphate.	Lyons.	1164
Read Fertilizer Co., New York city.	Farmers' friend.	Moravia.	1114
Read Fertilizer Co., New York city.	Leader guano.	Warsaw.	1231
Read Fertilizer Co., New York city.	N. Y. State brand	Moravia.	1115
Read Fertilizer Co., New York city.	Standard phosphate.	Warsaw.	1232
Read Fertilizer Co., New York city.	Standard superphosphate.	Moravia.	1113
Reese, John S. & Co., Baltimore, Md.	Challenge crop grower.	Knowlesville.	1191
Reese, John S. & Co., Baltimore, Md.	Pilgrim.	Knowlesville.	1192
Reese, John S. & Co., Baltimore, Md.	Potato special.	Knowlesville.	1193
Sanderson, Lucien, New Haven, Conn.	Formula A.	Jamaica.	1037
Sanderson, Lucien, New Haven, Conn.	Mixed formula top dressing.	Jamaica.	1036
Standard Fertilizer Co., Boston, Mass.	"A" brand.	Oneida.	1098
Standard Fertilizer Co., Boston, Mass.	Bone and potash.	Oneida. Chester.	1096 1067
Standard Fertilizer Co., Boston, Mass.	Dissolved bone.	Moravia.	1131
Standard Fertilizer Co., Boston, Mass.	Empire State special.	Chester. Oneida.	1065 1100

NEW YORK STATE FOR THE SPRING OF 1893 — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	3.3 to 4.1 3.58	4 to 5 4.34	8 to 11 8.14	1 to 2 0.94	9 to 13 9.08	7 to 8 7.62
Guaranteed. Found.	1.65 to 2.05 1.82	2 to 2.5 2.21	8 to 10 10.13	.... 1.75	.... 11.88	1.1 to 1.6 1.44
Guaranteed. Found.	2.05 to 2.9 2.2	2.5 to 3.5 2.67	9 to 11 9.64	2 to 4 0.96	11 to 14 10.6	2 to 4 2.2
Guaranteed. Found.	0.83 to 1.65 1.1	1 to 2 1.33	7 to 9 6.97	1 to 2 0.8	8 to 10 7.77	2 to 4 2.22
Guaranteed. Found.	1.25 to 2.05 1.53	1.5 to 2.5 1.86	9 to 11 9.57	2 to 4 0.59	11 to 13 10.16	2 to 4 1.88
Guaranteed. Found.	0.83 to 1.65 1.06	1 to 2 1.29	8 to 10 7.92	2 to 4 0.74	10 to 12 8.66	4 to 6 3.98
Guaranteed. Found.	0.83 to 1.65 1.09	1 to 2 1.32	8 to 10 8.21	2 to 4 0.54	10 to 12 8.75	4 to 6 4
Guaranteed. Found.	0.83 to 1.65 1.25	1 to 2 1.52	8 to 10 8.55	.... 1.39	.... 9.94	2 to 3 1.93
Guaranteed. Found.	1.25 to 1.65 1.5	1.5 to 2 1.82	6.5 to 8 8.03	.... 1.13	.... 9.16	3 to 4 3.71
Guaranteed. Found.	2.9 to 3.7 3.15	3.5 to 4.5 3.82	6 to 8 7.28	.... 0.8	.... 8.08	7.5 to 9.5 7.58
Guaranteed. Found.	3.3 to 4.1 2.98	4 to 5 3.62	6 to 8 8.08	2 to 4 1.87	10 to 12 9.95	6 to 8 7.47
Guaranteed. Found.	4.1 to 4.95 3.21	5 to 6 3.9	7 to 9 7.93	.... 1.52	.... 9.45	7 to 9 5.89
Guaranteed. Found.	1.25 to 2.05 1.49	1.5 to 2.5 1.81	6.5 to 8.5 9.16	1.5 to 2.5 1.12	8 to 11 10.28	1.1 to 1.6 1.06
Guaranteed. Found.	....	....	8 to 12 10.21	4 to 5 1.76	12 to 17 11.97	2.5 to 3.25 3.04
Guaranteed. Found.	....	....	12 to 15 12.16	1 to 2 1.83	13 to 16 13.99	....
Guaranteed. Found.	0.83 to 1.65 1.17	1 to 2 1.42	4 to 6 8.59	6 1.08	10 to 12 9.67	8 to 10 7.95

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Standard Fertilizer Co., Boston, Mass.	Guano.	Oneida. Chester.	1097 1068
Standard Fertilizer Co., Boston, Mass.	Hop special.	Oneida.	1099
Standard Fertilizer Co., Boston, Mass.	Potato and tobacco fertilizer.	Oneida.	1095
Sturtevant, F. E., Hartford, Conn.	Tobacco and sulphur lawn fertilizer.	Florida.	1071
Swift & Co., Chicago, Ill.	Pure ground steamed bone.	Ovid.	1203 1207
Swift & Co., Chicago, Ill.	Pure raw bone.	Ovid.	1202
Thomas, I. P. & Son, Philadelphia, Pa.	Improved superphosphate.	Queens. Florida.	1032 1074
Thomas, I. P. & Son, Philadelphia, Pa.	Normal bone phosphate.	Florida.	1075
Thomas, I. P. & Son, Philadelphia, Pa.	Potato manure.	Queens.	1031
Thomas, I. P. & Son, Philadelphia, Pa.	Tip top raw bone superphosphate.	Queens.	1033
Tygert, J. E., Co., Philadelphia, Pa.	Soluble bone and potash.	Fuller's Station.	1091
Tygert, J. E., Co , Philadelphia, Pa.	Star bone phosphate.	Fuller's Station.	1092
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Cabbage manure.	Hollis.	1027
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Potato manure.	Flatlands. Hollis. Mattituck.	1004 1026 1051
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Special brand potato manure.	Fuller's Station.	1090
Tygert-Allen Fertilizer Co., Philadelphia, Pa.	Star bone phosphate.	Fuller's Station.	1089

NEW YORK STATE FOR THE SPRING OF 1893 — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	1 to 2.5 1.24	1.25 to 3 1.5	8 to 12 8.21	2 to 3 1.49	10 to 15 9.7	2 to 3 2.32
Guaranteed. Found.	1.65 to 2.5 2.47	2 to 3 3	8 to 10 7.6	.... 1.57	.... 9.17	4.3 to 5.4 6.89
Guaranteed. Found.	2.05 to 2.9 2.08	2.5 to 3.5 2.53	8 to 11 9.76	1 to 2 1.83	9 to 13 11.59	3 to 4 2.53
Guaranteed. Found.	1.96 2.09	2.35 2.54	.... 0.75	.... 0.01	0.75 0.76	7.66 8
Guaranteed. Found.	3.3 to 4.1 3.13	4 to 5 3.8	.... 16.92	.... 8.96	20 to 24 25.88	....
Guaranteed. Found.	3.7 to 4.5 3.97	4.5 to 5.5 4.81	.... 16.38	.... 9.51	20 to 25 25.89	....
Guaranteed. Found.	0.33 to 0.54 0.45	0.4 to 0.65 0.55	12 to 15 13.51	2 to 3 1.22	14 to 18 14.73	....
Guaranteed. Found.	1 to 2.05 1.17	1.25 to 2.5 1.42	8.5 to 10 11.8	2 to 3 1.08	10.5 to 13 12.88	1.5 to 3 1.74
Guaranteed. Found.	2.5 to 3.3 2.51	3 to 4 3.05	9 to 11 9.3	1 to 2 1.07	10 to 13 10.37	6 to 8 5.86
Guaranteed. Found.	2.5 to 4.1 2.5	3 to 5 3.04	10 to 12 10.51	2 to 3 1	12 to 15 11.51	2.75 to 4 4.68
Guaranteed. Found.	....	....	11 to 14 11.65	.... 0.65	.... 12.3	2 to 3 1.85
Guaranteed. Found.	1.85 to 2.9 1.26	2.25 to 3.5 1.53	9 to 11 9.5	2 to 3 1.46	11 to 14 10.96	2.5 to 3.5 2.55
Guaranteed. Found.	3.7 to 4.5 3.39	4.5 to 5.5 4.12	7 to 8 8.17	1 to 2 1.13	9 to 10 9.3	5 to 6 5.18
Guaranteed. Found.	3.3 to 4.1 3.2	4 to 5 3.88	6 to 7 7.28	3 1.48	9 to 10 8.76	9 to 10 9.08
Guaranteed. Found.	2.05 to 2.9 2.11	2.5 to 3.5 2.56	6 to 8 7.02	.... 1.78	.... 8.8	6 to 8 5.92
Guaranteed. Found.	1.85 to 2.5 1.95	2.25 to 3 2.37	8.5 to 11 8.99	2 to 3 2.45	10.5 to 14 11.44	2.25 to 3.25 2.54

XX. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Walker Fertilizer Co., Clifton Springs, N. Y.	Ammoniated phosphate.	Sodus.	1147
Walker Fertilizer Co., Clifton Springs, N. Y.	Clifton.	Sodus.	1144
Walker Fertilizer Co., Clifton Springs, N. Y.	Hop and tobacco grower.	Sodus.	1146
Walker Fertilizer Co., Clifton Springs, N. Y....	Potato and vegetable grower.	Sodus.	1145
Walker Fertilizer Co., Clifton Springs, N. Y....	Victoria bone.	Albion.	1195
Williams & Clark Fertilizer Co., New York city.	Acorn acid phosphate.	Township.	1084
Williams & Clark Fertilizer Co., New York city.	Americus high grade special for potatoes and vegetables.	Chester.	1066
Williams & Clark Fertilizer Co , New York city.	Carteret bone meal.	Township.	1083
Williams & Clark Fertilizer Co., New York city	Prolific crop producer.	Sempronius.	1129
Williams & Clark Fertilizer Co., New York city	Potato phosphate.	Jamaica.	1040
Williams & Clark Fertilizer Co., New York city.	Royal bone phosphate.	Township.	1085

NEW YORK STATE FOR THE SPRING OF 1893 — (*Concluded*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available	Insoluble.	Total.	
Guaranteed. Found.	1.65 to 2.5 1.66	2 to 3 2.01	7 to 9 6.59	2 to 5 2.56	9 to 14 8.95	1 to 2 0.45
Guaranteed. Found.	2.5 to 3.3 2.94	3 to 4 3.57	10 to 12 9.59	2 to 3 0.39	12 to 15 9.98	2.5 to 3.5 2.87
Guaranteed. Found.	3.3 to 4.1 3.58	4 to 5 4.34	6 to 8 5.24	1 to 2 2.88	7 to 10 8.12	5 to 6 4.03
Guaranteed. Found.	2.5 to 3.3 2.45	3 to 4 2.97	6 to 8 6.07	1 to 2 0.42	7 to 10 6.49	7 to 8 6.29
Guaranteed. Found.	0.83 to 1.65 1.09	1 to 2 1.32	8 to 10 7.05	.... 2.8	.... 9.85	1.6 to 2.7 1.15
Guaranteed. Found.	....	....	12 to 15 11.9	1 to 2 1.81	13 to 17 13.71	....
Guaranteed. Found.	2.7 to 4.1 3.54	4.5 to 5 4.29	7 to 9 7.86	1 to 2 0.88	8 to 11 8.74	7 to 9 7.03
Guaranteed. Found.	1.65 to 2.5 2.04	2 to 3 2.48	.... 2.11	.... 11.18	14 to 18 13.29	....
Guaranteed. Found.	0.83 to 1.65 1.09	1 to 2 1.32	6 to 9 7.56	1 to 2 1.35	7 to 11 8.91	1 to 2 1.44
Guaranteed. Found.	2.5 to 3.3 2.7	3 to 4 3.28	7 to 8 7.38	1 1.05	8 to 9 8.43	6 to 8 4.93
Guaranteed. Found.	1 to 1.65 1.28	1.25 to 2 1.55	7 to 9 7.72	1 to 2 2.06	8 to 11 9.78	2 to 3 2.2

XXI. RESULTS OF ANALYSES OF COMMERCIAL FERTILI

Composition of fertilizers as guaranteed by manufacturers, and

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bowker Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Mt. Morris.	1336
Bowker Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Waterloo.	1282
Bowker Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Webster.	1340
Bowker Fertilizer Co., Boston, Mass.	Hill and drill.	Clyde.	1313
Bowker Fertilizer Co., Boston, Mass.	Hill and drill.	Geneseo.	1328
Bowker Fertilizer Co., Boston, Mass.	Hill and drill.	Penn Yan.	1285
Bowker Fertilizer Co., Boston, Mass.	Hill and drill.	Webster.	1341
Bowker Fertilizer Co., Boston, Mass.	Sure crop.	Mt. Morris.	1337
Bowker Fertilizer Co., Boston, Mass.	Sure crop.	Penn Yan.	1286
Bowker Fertilizer Co., Boston, Mass.	Sure crop.	Romulus.	1277
Bradley Fertilizer Co., Boston, Mass.	Alkaline bone.	Trumansburg.	1265
Bradley Fertilizer Co., Boston, Mass.	Ammoniated dissolved bone.	Parma Center.	1356
Bradley Fertilizer Co., Boston, Mass.	Farmer's new method.	Dresden.	1253
Bradley Fertilizer Co., Boston, Mass.	Eureka superphosphate.	Avon.	1317
Bradley Fertilizer Co., Boston, Mass.	Patent superphosphate.	Avon.	1318
Bradley Fertilizer Co., Boston, Mass.	Patent superphosphate.	Dresden.	1254

ZERS IN NEW YORK STATE FOR THE FALL OF 1893.

as found by chemical analysis. Expressed in parts per hundred.

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed.	1.65 to 2.5	2 to 3	8 to 10	....	10 to 12	2 to 3
Found.	0.95	1.15	9.92	2.27	12.19	1.73
Guaranteed.	1.65 to 2.5	2 to 3	8 to 10	....	10 to 12	2 to 3
Found.	1.84	2.23	8.56	1.63	10.19	2.66
Guaranteed.	1.65 to 2.5	2 to 3	8 to 10	....	10 to 12	2 to 3
Found.	1.58	1.92	9.52	3.07	12.59	2.07
Guaranteed.	2.05 to 2 9	2.5 to 3.5	8 to 10	2	10 to 12	2 to 3
Found.	2.24	2.72	8.34	2.29	10.63	2.34
Guaranteed.	2.05 to 2.9	2.5 to 3.5	8 to 10	....	10 to 12	2 to 3
Found.	1.95	2.37	10.23	2.56	12.79	1.85
Guaranteed.	2.05 to 2.9	2.5 to 3.5	8 to 10	....	10 to 12	2 to 3
Found.	1.93	2.34	8.38	4.11	12.49	2.5
Guaranteed.	2.05 to 2.9	2.5 to 3.5	8 to 10	....	10 to 12	2 to 3
Found.	1.84	2.23	9.32	3.12	12.44	2.22
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	....	10 to 12	1 to 2
Found.	0.87	1.06	10.66	1.95	12.61	1.2
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	....	10 to 12	1 to 2
Found.	0.81	0.98	11.5	1.69	13.19	1.02
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	2	10 to 12	1 to 2
Found	0.9	1.09	8.86	3.86	12.72	1.14
Guaranteed.	....	....	11 to 15	1 to 2	12 to 17	2.45 to 3 5
Found.	....	....	10.95	2.97	13.92	2.4
Guaranteed.	1.65 to 2.5	2 to 3	7 to 9	....	8 to 10	1 to 2
Found.	1.89	2.29	9	2.84	11.84	1.78
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	1 to 2	10 to 12	2.15 to 3.25
Found.	1.16	1.41	8 62	1.9	10.52	2.14
Guaranteed.	....	....	9 to 11	1 to 2	10 to 13	3.25 to 4.3
Found.	....	....	10.96	2.75	13.71	3.14
Guaranteed.	2.05 to 2.9	2.5 to 3.5	8 to 10	2	10 to 12	1.5 to 2.5
Found.	2.13	2.59	10.47	1.57	12.04	1.52
Guaranteed.	2.05 to 2.9	2.5 to 3.5	8 to 10	2	10 to 12	1.5 to 2.5
Found.	2.1	2.55	9.48	3.51	12.99	1.37

XXI. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Bradley Fertilizer Co., Boston, Mass.	Patent superphosphate	Somerset.	1370
Bradley Fertilizer Co., Boston, Mass.	Sea fowl guano.	Penn Yan.	1291
Bradley Fertilizer Co., Boston, Mass.	X L superphosphate of lime.	Penn Yan.	1290
Bradley, Wm. L., Boston, Mass.	Sea fowl guano.	Somerset.	1369
Chemical Co. of Canton, Baltimore, Md.	High grade Baker's standard guano.	Gage.	1294
Clark's Cove Fertilizer Co., New York city.	Bay State fertilizer.	Dresden.	1248
Clark's Cove Fertilizer Co., New York city.	King Philip alkaline guano.	Somerset.	1368
Coe, E. Frank, New York city.	Alkaline bone.	Mt. Morris.	1339
Coe, E. Frank, New York city.	Ammoniated bone superphosphate.	Waterloo.	1281
Coe, E. Frank, New York city.	XXV ammoniated bone superphosphate.	Mt. Morris.	1338
Crocker Fertilizer & Chemical Co., Buffalo, N.Y.	Ammoniated wheat and corn phosphate.	Farmer.	1269
Crocker Fertilizer & Chemical Co., Buffalo, N.Y.	Ammoniated wheat and corn phosphate.	Gage.	1296
Crocker Fertilizer & Chemical Co., Buffalo, N.Y.	Ammoniated wheat and corn phosphate.	Geneseo.	1333
Crocker Fertilizer & Chemical Co., Buffalo, N.Y.	Ammoniated wheat and corn phosphate.	Mt. Morris.	1335
Crocker Fertilizer & Chemical Co , Buffalo, N.Y	Ammoniated wheat and corn phosphate.	E Kendall.	1360

NEW YORK STATE FOR THE FALL OF 1893 — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	2.05 to 2.9 2.32	2.5 to 3.5 2.82	8 to 10 9.71	.... 2.95	10 to 12 12.66	1.5 to 2.5 1.94
Guaranteed. Found.	2.05 to 2.9 2.33	2.5 to 3.5 2.83	8 to 10 9.38	.... 2.84	10 to 12 12.22	1.5 to 2.5 1.76
Guaranteed. Found.	2.5 to 3.3 2.64	3 to 4 3.2	9 to 11 10.07	2 to 3 1.81	11 to 14 11.88	2 to 3 2.37
Guaranteed. Found.	2.05 to 2.9 2.05	2.5 to 3.5 2.5	8 to 10 10.29	.... 2.95	10 to 12 13.24	1.5 to 2.5 1.76
Guaranteed. Found.	2.05 to 2.9 2.2	2.5 to 3.5 2.68	9 to 11 9.95	.... 1.29	.... 11.24	2.5 to 3.5 2.77
Guaranteed. Found.	2.5 to 3.3 2.55	3 to 4 3.1	8 to 11 9.97	1.5 to 3 1.07	9.5 to 14 11.04	2 to 3 1.55
Guaranteed. Found.	1.25 to 1.65 1.4	1.5 to 2 1.7	6 to 8 7.26	.... 4.14	7 to 10 11.4	3 to 4 2.93
Guaranteed. Found.	1.25 to 1.65 1.26	1.5 to 2 1.53	9 to 12 9.54	2 to 3 2.4	.... 11.94	1.85 2.17
Guaranteed. Found.	1.65 to 2.05 1.7	2 to 2.5 2.06	8 to 10 9.74	1 to 2 2.48	9 to 12 12.22	1.35 1.47
Guaranteed. Found.	1 to 1.5 1.1	1.25 to 1.75 1.33	9 to 10 10.01	1 to 2 3.63	10 to 12 13.64	1 1.3
Guaranteed. Found.	2.05 to 2.9 2.24	2.5 to 3.5 2.72	10 to 13 9.43	1 to 2 0.87	11 to 15 10.30	1.6 to 2.7 1.94
Guaranteed. Found.	2.05 to 2.9 2.41	2.5 to 3.5 2.93	10 to 13 9.3	1 to 2 1.12	.... 10.42	1.6 to 2.7 1.95
Guaranteed. Found.	2.05 to 2.9 2.5	2.5 to 3.5 3.04	10 to 13 9.65	1 to 2 1.23	11 to 15 10.88	1.6 to 2.7 1.91
Guaranteed. Found.	2.05 to 2.9 2.01	2.5 to 3.5 2.44	10 to 13 10.4	1 to 2 0.2	11 to 15 10.6	1.6 to 2.7 1.51
Guaranteed. Found.	2.05 to 2.9 2.5	2.5 to 3.5 3.04	10 to 13 9.4	1 to 2 0.8	.... 10.2	1.6 to 2.7 1.85

XXI. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Crocker Fertilizer & Chemical Co., Buffalo, N.Y.	Dissolved bone black.	Mt. Morris.	1334
Crocker Fertilizer & Chemical Co., Buffalo, N.Y.	Ground bone meal.	Lyndonville.	1367
Crocker Fertilizer & Chemical Co., Buffalo, N.Y.	New rival ammoniated superphosphate.	E. Kendall.	1361
Cross, E. A., North Parma, N. Y.	King superphosphate.	N. Parma.	1352
Cross, E. A., North Parma, N. Y.	Parma phosphate.	N. Parma.	1354
Cross, E. A., North Parma, N. Y.	Queen superphosphate.	N. Parma.	1353
Farmer Fertilizer Co., Syracuse, N. Y.	Standard special formula.	Magee's Corners.	1278
Great Eastern Fertilizer Co., New York city.	General wheat special.	Waterloo.	1279
Lister Agricultural and Chemical Works, Newark, N. J.	Ammoniated dissolved bone phosphate.	Stanley.	1302
Lister Agricultural and Chemical Works, Newark, N. J.	Perfect.	Geneseo.	1330
Lister Agricultural and Chemical Works, Newark, N. J.	Perfect.	Kendall.	1357
Lister Agricultural and Chemical Works, Newark, N. J.	Pure bone superphosphate.	Webster.	1344
Lister Agricultural and Chemical Works, Newark, N. J.	Standard superphosphate of lime.	Dresden.	1252
Lister Agricultural and Chemical Works, Newark, N. J.	Standard superphosphate of lime.	Geneseo.	1331
Lister Agricultural and Chemical Works, Newark, N. J.	Success.	Dundee.	1243
Lister Agricultural and Chemical Works, Newark, N. J.	Success	Webster.	1345

NEW YORK STATE FOR THE FALL OF 1893 — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed.	....	....	16 to 18	....	....	....
Found.	....	....	15.72	0.91	16.63	....
Guaranteed	2.05 to 3.3	2.5 to 4	....	....	25 to 28	....
Found.	1.17	1.42	....	....	30.35	....
Guaranteed.	1.25 to 2.05	1.5 to 2.5	10 to 12	1 to 2	....	1.6 to 1.7
Found.	1.25	1.52	10.27	1.39	11.66	1.92
Guaranteed.	2.05 to 2.9	2.5 to 3	7 to 9	....	6 to 11	2 to 3
Found.	2.29	2.78	7.07	2.27	9.34	3.5
Guaranteed.	0.83 to 1.25	1 to 1.5	7 to 8	....	8 to 10	2 to 3
Found.	1.58	1.92	7.64	1.3	8.94	4.11
Guaranteed.	1.25 to 1.65	1.5 to 2	7 to 9	....	9 to 11	2 to 3
Found.	2	2.43	8.11	1.68	9.79	3.55
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	....	10 to 12	2.15 to 3.25
Found.	1.38	1.55	8.28	2.55	10.83	1.63
Guaranteed.	1.65 to 2.5	2 to 3	8 to 12	1 to 3	9 to 15	1.6 to 2.7
Found.	1.66	2.01	8.37	1.36	9.73	2.21
Guaranteed.	1.65 to 2.05	2 to 2.5	9 to 10	2 to 3	11 to 13	1 to 2
Found.	2.23	2.7	9.14	2.75	11.89	1.5
Guaranteed.	1.25 to 1.65	1.5 to 2	9.5 to 11	....	....	1.5 to 2.5
Found.	1.5	1.82	10.09	2.21	12.3	1.21
Guaranteed.	1.25 to 1.65	1.5 to 2	9.5 to 11	....	....	1.5 to 2.5
Found.	1.47	1.78	8.56	2.98	11.54	1.95
Guaranteed.	2.35 to 2.7	2.85 to 3.25	10 to 12	2 to 3	....	1.5 to 2
Found.	2.43	2.95	10.01	3.13	13.14	2.17
Guaranteed.	2.35 to 2.7	2.85 to 3.25	10 to 12	2 to 3	12 to 15	1.5 to 2
Found.	2.54	3.08	9.83	2.22	12.05	1.66
Guaranteed.	2.35 to 2.7	2.85 to 3.25	10 to 12	2 to 3	....	1.5 to 2
Found.	2.47	3	9.6	2.57	12.17	1.71
Guaranteed.	1.25 to 1.65	1.5 to 2	9.5 to 11	....	....	1.5 to 2
Found.	1.96	2.38	9.14	2.24	11.38	1.47
Guaranteed.	1.25 to 1.65	1.5 to 2	9.5 to 11	....	....	1.5 to 2
Found.	1.69	2.05	10.28	2.51	12.79	1.5

XXI. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Ludlam, Frederick, New York city.	Cereal brand.	Farmer.	1270
Maryland Fertilizer Co., Baltimore, Md.	Seneca Chief ammoniated dissolved bone.	Waterloo.	1284
Maryland Fertilizer and Manufacturing Co., Baltimore, Md.	Alkaline bone.	Avon.	1325
Maryland Fertilizer and Manufacturing Co., Baltimore, Md.	Globe complete manure.	Avon.	1324
Maryland Fertilizer and Manufacturing Co., Baltimore, Md.	Linden superphosphate.	Avon.	1326
Michigan Carbon Works, Detroit, Mich.	Homestead.	Penn Yan.	1293
Michigan Carbon Works, Detroit, Mich.	Homestead.	Union Hill.	1351
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Alkaline bone.	Avon.	1320
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Buffalo fertilizer.	Newark.	1314
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Buffalo fertilizer.	Yates.	1364
Milsom Rendering and Fertilizer Co., Buffalo, N Y.	Cyclone pure bone meal.	Yates.	1363
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Cyclone pure bone meal.	Newark.	1316
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Potato, hop and tobacco fertilizer.	Avon.	1321
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Potato, hop and tobaco phosphate.	Yates.	1365
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Wheat, oats and barley phosphate.	Dundee.	1242
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Wheat, oats and barley phosphate.	Waterloo.	1283

NEW YORK STATE FOR THE FALL OF 1893 — (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	....	10 to 12	1 to 2
Found.	0.79	0.96	9.17	4.95	14.12	1.36
Guaranteed.	1.65 to 2.5	2 to 3	9 to 12	....	....	1.5 to 2
Found.	1.66	2.01	8.48	3.34	11.82	1.81
Guaranteed.	....	....	11 to 15	1 to 2	12 to 17	3 to 4
Found.	....	....	11.46	0.6	12.06	3.92
Guaranteed.	1.5 to 2.05	1.75 to 2.5	9 to 12	1 to 2	10 to 14	1.5 to 2.25
Found.	1.55	1.88	9.17	2.98	12.15	1.45
Guaranteed.	....	....	10 to 13	1 to 2	11 to 15	2 to 4
Found.	....	....	11.69	1.02	12.71	1.63
Guaranteed.	1.85 to 2.4	2.25 to 3.15	8 to 11	....	....	1.5 to 1.9
Found.	2.55	3.1	8.11	1.61	9.72	1.28
Guaranteed.	1.85 to 2.5	2.25 to 3	8 to 11	....	....	1.5 to 1.9
Found.	2.11	2.56	9.21	1.40	10.61	1.89
Guaranteed.	....	....	11 to 13	1.37 to 2.37	12.37 to 15.37	3.25 to 4.3
Found.	....	....	9.63	0.5	10.13	1.09
Guaranteed.	2.5 to 3.85	3 to 4.65	8 to 12.3	2 to 3	10 to 15.3	1.5 to 2.5
Found.	2.24	2.72	7.55	2.6	10.15	0.71
Guaranteed.	2.5 to 3.85	3 to 4.65	8 to 12.3	....	10 to 15.3	1.5 to 2.5
Found.	1.86	2.26	9	2.24	11.24	0.83
Guaranteed.	3.3 to 4.1	4 to 5	....	....	25	....
Found.	3.13	3.8	19.44	5.23	24.67	....
Guaranteed.	3.3 to 4.1	4 to 5	....	....	25	....
Found.	3.95	4.79	12.17	11.83	24	....
Guaranteed.	2.5 to 3.3	3 to 4	8 to 11	1 to 2	9 to 13	5 to 6
Found.	1.94	2.35	8.04	2.74	10.78	2.34
Guaranteed.	2.5 to 3.3	3 to 4	8 to 11	1 to 2	9 to 13	5 to 6
Found.	1.97	2.39	8.55	2.79	11.34	3.16
Guaranteed.	1.65 to 3.3	2 to 4	8 to 10	2 to 3	10 to 13	2 to 3
Found.	1.12	1.36	6.26	2.52	8.78	0.83
Guaranteed.	1.65 to 3.3	2 to 4	8 to 10	2 to 3	10 to 13	2 to 3
Found.	1.11	1.35	7.12	2.56	9.68	1.55

XXI. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken	Station number.
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Wheat, oats and barley phosphate.	Newark.	1315
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Wheat, oats and barley phosphate.	Avon.	1319
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Wheat, oats and barley phosphate.	Webster.	1349
Milsom Rendering and Fertilizer Co., Buffalo, N. Y.	Wheat, oats and barley phosphate.	Yates.	1366
Newark Chemical Works, Newark, N. J.	Ammoniated dissolved bone.	Kendall.	1358
Newark Chemical Works, Newark, N J.	Columbia phosphate.	Geneseo.	1327
Newark Chemical Works, Newark, N. J.	Harvest Queen.	Kendall.	1359
Oakfield Fertilizer Co., Oakfield, N. Y.	Domestic.	Webster.	1342
Oakfield Fertilizer Co., Oakfield, N. Y.	Standard.	Webster.	1343
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	A. A. brand superphosphate.	Oneonta.	1310
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	Domestic brand superphosphate	Oneonta.	1312
Oneonta Fertilizer and Chemical Co., Oneonta, N. Y.	Success brand superphosphate	Oneonta.	1311
Pacific Guano Co., New York city.	Nobsque guano.	Ovid.	1275
Pacific Guano Co., New York city.	Nobsque guano.	Stanley.	1304
Pacific Guano Co., New York city.	Soluble Pacific guano.	Stanley.	1305
Phillips, Moro, Chemical Co., 131 South Third street, Philadelphia, Pa.	Alkaline bone phosphate.	Dresden.	1262

NEW YORK STATE FOR THE FALL OF 1893 — (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed. Found.	1.65 to 3.3 1.48	2 to 4 1.8	8 to 10 6.58	2 to 3 2.89	10 to 13 9.47	2 to 3 0.82
Guaranteed. Found.	1.65 to 3.3 1.17	2 to 4 1.42	8 to 10 6.84	2 to 3 2.3	10 to 13 9.14	2 to 3 1.27
Guaranteed. Found.	1.65 to 3.3 1.83	2 to 4 2.22	8 to 10 7.62	2 to 3 3.34	10 to 13 10.96	2 to 3 1.76
Guaranteed. Found.	1.65 to 3.3 1.2	2 to 4 1.46	8 to 10 6.63	2 to 3 3.07	10 to 13 9.07	2 to 3 1.8
Guaranteed. Found.	1.85 1.49	2.25 1.81	9 10.94	1.5 1.73	10.5 12.67	2.5 2.38
Guaranteed Found.	1.25 to 2.05 1.68	1.5 to 2.5 2.04	6 to 8 9.87	1.5 to 2 4.1	7.5 to 10 13.97	1.5 to 2 2.75
Guaranteed. Found.	1 to 1.65 1.51	1.25 to 2 1.83	10 to 12 9.33	1.5 to 2 3.3	.... 12.63	2.5 to 3 2.56
Guaranteed. Found.	1.65 to 2.5 1.68	2 to 3 2.04	8 to 10 7.65	1 to 2 2.6	9 to 12 10.25	1.1 to 1.6 1.71
Guaranteed. Found.	2.5 to 3.3 2.62	3 to 4 3.18	10 to 12 10.44	1 to 2 2.16	11 to 14 12.6	1.6 to 2.15 1.91
Guaranteed. Found.	2.5 to 3.3 2.91	3 to 4 3.53	10 to 12 11.84	2 to 4 1.16	12 to 16 13	2.5 to 3.5 2.75
Guaranteed. Found.	1.65 to 2.5 3.18	2 to 3 3.86	8 to 10 10.17	2 1.64	10 to 12 11.81	2 to 3 2.41
Guaranteed. Found.	0.83 to 1.65 2.09	1 to 2 2.54	9 to 11 10.95	2 1.29	11 to 13 12.24	1 to 2 1.57
Guaranteed. Found.	1.5 to 2 1.22	1.8 to 2.4 1.48	8 to 12 8.07	1 to 2 3.74	9 to 14 11.81	2 to 3 1.83
Guaranteed. Found	1.25 to 1.65 1.26	1.5 to 2 1.53	8 to 12 7.79	1 to 2 3.54	9 to 14 11.33	2 to 3 2.29
Guaranteed. Found.	2.05 to 2.9 2.13	2.05 to 3.5 2.59	8 to 11 9.39	2 to 3 0.31	10 to 14 9.7	2 to 3.5 2.32
Guaranteed. Found.	....	....	11 to 13 10.6	1 0.83	12 to 14 11.43	2.25 to 3 2.7

XXI. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade, name or brand.	Locality where sample was taken.	Station number.
Phillips, Moro, Chemical Co., 131 South Third street, Philadelphia, Pa.	Alkaline bone phosphate.	Farmer.	1274
Phillips, Moro, Chemical Co., 131 South Third street, Philadelphia, Pa.	C. and G. complete fertilizer.	Dresden.	1260
Phillips, Moro, Chemical Co., 131 South Third street, Philadelphia, Pa.	C. and G. complete fertilizer.	Farmer.	1271
Phillips, Moro, Chemical Co., 131 South Third street, Philadelphia, Pa.	Guarantee guano.	Farmer.	1272
Phillips, Moro, Chemical Co., 131 South Third street, Philadelphia, Pa.	Potato manure No. 2.	Farmer.	1273
Phillips, Moro, Chemical Co., 131 South Third street, Philadelphia, Pa.	Potato manure No. 2.	Dresden.	1261
Quinnipiac Co., New York city.	Ammoniated dissolved bone.	Dundee.	1247
Quinnipiac Co., New York city.	Ammoniated dissolved bone.	Gorham.	1308
Quinnipiac Co., New York city.	Climax.	Dundee.	1246
Quinnipiac Co., New York city.	Mohawk.	Dundee.	1245
Rasin Fertilizer Co., Baltimore.	Acid phosphate.	Penn Yan.	1287
Read Fertilizer Co., New York city.	Farmers' friend.	Penn Yan.	1289
Read Fertilizer Co., New York city.	Farmers' friend.	Webster.	1347
Read Fertilizer Co., New York city.	Leader guano.	Trumansburg.	1263
Read Fertilizer Co., New York city.	New York State superphosphate.	Webster.	1348
Read Fertilizer Co., New York city.	Standard phosphate.	Webster.	1346
Read Fertilizer Co., New York city.	Standard phosphate.	Trumansburg.	1264

NEW YORK STATE FOR THE FALL OF 1893 — (*Continued*).

	NITROGEN.		PHOSPHORIC ACID			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed.	....	....	11 to 13	....	12 to 14	2.25 to 3
Found.	....	....	10.45	0.66	11.11	2.44
Guaranteed.	1 to 1.65	1.25 to 2	8 to 10	1 to 2	9 to 12	1.25 to 2
Found.	0.8	0.97	9.44	1.14	10.58	1.66
Guaranteed.	1 to 1.65	1.25 to 2	8 to 10	1 to 2	9 to 12	1.25 to 2
Found.	1	1.21	8.43	0.88	9.31	1.59
Guaranteed.	1.25 to 1.85	1.5 to 2.25	9.25 to 11.25	1 to 2	10.25 to 13.25	1.4 to 2.25
Found.	1.05	1.27	8.94	2.55	11.49	2.32
Guaranteed.	1.85 to 2.7	2.25 to 3.25	9 to 10	....	....	4.75 to 5.75
Found.	1.61	1.95	9.39	1.42	10.81	5.24
Guaranteed.	1.85 to 2.7	2.25 to 3.25	9 to 10	....	....	4.75 to 5.75
Found.	1.42	1.72	9.65	0.89	10 54	4.48
Guaranteed.	1.65 to 2.5	2 to 3	9 to 12	1 to 2	10 to 14	2 to 3
Found.	1.79	2.17	10	3.03	13.03	1.89
Guaranteed.	1.65 to 2.5	2 to 3	9 to 12	1 to 2	10 to 14	2 to 3
Found.	1.99	2.42	10 98	3.13	14.11	1.91
Guaranteed.	1 to 1.65	1.25 to 2	8 to 11	1 to 2	9 to 13	2 to 3
Found.	1.37	1.66	8.43	4.36	12.79	1.97
Guaranteed.	0.83 to 1.65	1 to 2	7 to 9	1 to 2	8 to 11	1 to 2
Found.	1.22	1.48	6.78	4.9	11.68	1.19
Guaranteed.	....	....	14	1	15	....
Found.	....	....	15.23	0.37	15.6	....
Guaranteed.	2.05 to 2.9	2.5 to 3.5	9 to 11	2 to 4	11 to 14	2 to 4
Found.	1.96	2.38	8.91	1.19	10.1	2.26
Guaranteed.	2.05 to 2.9	2.5 to 3.5	9 to 11	2 to 4	11 to 14	2 to 4
Found.	1.97	2.39	9.01	1.45	10 46	2.35
Guaranteed.	0.83 to 1.65	1 to 2	7 to 9	1 to 2	8 to 10	2 to 4
Found.	1.11	1.35	7.35	0.43	7.78	2.15
Guaranteed.	1.25 to 2.05	1.5 to 2.5	9 to 11	2 to 4	11 to 13	2 to 4
Found.	1.34	1.63	10.21	0.55	10.76	2.19
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	2 to 4	10 to 12	4 to 6
Found.	0.9	1.09	8.04	1.13	9.17	3.99
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	2 to 4	10 to 12	4 to 6
Found.	0.96	1.17	7.96	1.08	9.04	4.01

XXI. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Reese, John S. & Co., Baltimore, Md.	Crown bone phosphate and potash.	Penn Yan.	1295
Reese, John S & Co., Baltimore, Md.	May flower.	Dresden.	1250
Reese, John S. & Co., Baltimore, Md.	New England favorite.	Dresden.	1249
Reese, John S. & Co., Baltimore, Md.	Pilgrim.	Dresden.	1251
Reese, John S. & Co., Baltimore, Md.	Pilgrim.	Geneva.	1241
Rochester Fertilizer Co., Rochester, N. Y.	Alkaline bone guano.	Stanley.	1303
Rochester Fertilizer Co , Rochester, N. Y.	Blood and bone guano.	Dundee.	1244
Rochester Fertilizer Co., Rochester, N. Y.	Blood and bone guano.	Penn Yan.	1292
Rochester Fertilizer Co., Rochester, N. Y.	Blood and bone guano.	Webster.	1350
Sharretts, E. A. & Co., 1330 Philpot street, Baltimore, Md.	Ammoniated bone.	Stanley.	1300
Standard Fertilizer Co., Boston, Mass.	W. C. Lowe's special wheat, oats and barley fertilizer.	Geneseo.	1332
Standard Fertilizer Co., Boston, Mass.	Standard bone and potash.	Gorham.	1307
Standard Fertilizer Co., Boston, Mass.	Standard "A" brand.	Avon.	1323
Standard Fertilizer Co., Boston, Mass.	Standard guano.	Penn Yan.	1294
Standard Fertilizer Co., Boston, Mass.	Standard guano.	Gorham.	1306
Standard Fertilizer Co., Boston, Mass.	Standard guano.	Avon.	1322

NEW YORK STATE FOR THE FALL OF 1893 — (*Continued*).

	Nitrogen.		Phosphoric Acid.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Available.	Insoluble.	Total.	
Guaranteed.	....	....	10 to 13	....	12 to 15	2 to 3
Found.	....	....	10.45	3.51	13.96	2.35
Guaranteed.	1 85 to 2.5	2.25 to 3	8.5 to 10	1.5 to 3	10 to 13	2.25 to 3
Found.	1.83	2.22	8.63	1.54	10.17	2.93
Guaranteed	2.5 to 3.3	3 to 4	9 to 12	1 to 2	10 to 14	2 to 3
Found.	2.46	2.99	8.94	1.31	10.25	2.22
Guaranteed.	1.25 to 1.65	1.5 to 2	6.5 to 8	1 to 2.5	7.5 to 10.5	3 to 4
Found.	1.16	1.41	7.45	2.05	9.5	3.08
Guaranteed.	1.25 to 1.65	1.5 to 2	6.5 to 8	1 to 2.5	7.5 to 10.5	3 to 4
Found.	1.41	1.71	7.9	1.95	9.85	3.26
Guaranteed.	0.4	0.5	8 to 10	....	....	3 to 5
Found.	0.47	0.57	6.01	1.13	7.14	3.69
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	....	....	1.6 to 2.7
Found.	1.02	1.24	8.71	1.16	9.87	2.47
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	....	....	1.6 to 2.7
Found.	1.02	1.24	7.37	1.09	8.46	1.72
Guaranteed.	0.83 to 1.65	1 to 2	8 to 10	....	....	1.6 to 2.7
Found.	0.83	1.01	7.56	0.76	8.32	4.57
Guaranteed.	0.4 to 1	0.5 to 1.25	5 to 7	1 to 2	....	1 to 2
Found.	0.72	0.87	5.81	1.02	6.83	1.78
Guaranteed.	....	....	10 to 12	....	....	4.95 to 5.4
Found.	....	....	10.84	2.81	13.65	3.39
Guaranteed.	....	....	8 to 12	4 to 5	12 to 17	2.5 to 3.25
Found.	....	....	10.46	3.09	13.55	2.54
Guaranteed.	1.25 to 2.05	1.5 to 2.5	6.5 to 8.5	1.5 to 2.5	8 to 11	1.3 to 1.9
Found.	1.54	1.87	8.19	1.87	10.06	1.3
Guaranteed.	1 to 2.5	1.25 to 3	8 to 12	2 to 3	10 to 15	2 to 3
Found.	1.14	1.38	9.2	1.74	10.94	2.02
Guaranteed.	1 to 2.5	1.25 to 3	8 to 12	2 to 3	10 to 15	2 to 3
Found.	2.27	2.76	8.06	2.95	11.01	2.42
Guaranteed.	1 to 2.5	1.25 to 3	8 to 12	2 to 3	10 to 15	2 to 3
Found.	1.17	1.42	8.9	1.9	10.8	2.4

XXI. RESULTS OF ANALYSES OF COMMERCIAL FERTILIZERS IN

MANUFACTURER.	Trade name or brand.	Locality where sample was taken.	Station number.
Standard Fertilizer Co., Boston, Mass.	Standard fertilizer.	Parma Center.	1355
Stone, R. H , Trumansburg, N. Y.	King.	Trumansburg.	1268
Stone, R. H., Trumansburg, N. Y.	Eureka.	Trumansburg.	1276
Thomas, I. P. & Son, Philadelphia, Pa.	Peach tree fertilizer.	Geneseo.	1329
Walker Fertilizer Co., Clifton Springs, N. Y.	Ammoniated phosphate.	Dresden.	1259
Walker Fertilizer Co., Clifton Springs, N. Y.	Economical bone phosphate.	Dresden.	1258
Walker, Stratman & Co., Pittsburg, Pa.	Banner.	Dresden.	1255
Walker, Stratman & Co., Pittsburg, Pa.	Big bonanza.	Dresden.	1257
Walker, Stratman & Co., Pittsburg, Pa.	Fourfold.	Dresden.	1256
Walker, Stratman & Co., Pittsburg, Pa.	Fourfold.	Gorham.	1309
Walker, Stratman & Co., Pittsburg, Pa.	Fourfold.	Ransomville.	1372
Walker, Stratman & Co., Pittsburg, Pa.	Magnolia.	Penn Yan.	1288
Williams & Clark Fertilizer Co., New York city.	Acorn brand acid phosphate.	Trumansburg.	1266
Williams & Clark Fertilizer Co., New York city.	Americus brand pure bone meal.	Trumansburg.	1267
Williams & Clark Fertilizer Co., New York city.	Royal bone phosphate.	Waterloo.	1280
Williams & Clark Fertilizer Co., New York city.	Royal bone phosphate.	Ransomville.	1371
Zell Guano Co., Baltimore, Md.	Calvert guano.	Stanley.	1298
Zell Guano Co., Baltimore, Md.	Economizer.	Stanley.	1299

NEW YORK STATE FOR THE FALL OF 1893 -- (*Concluded*).

	NITROGEN.		PHOSPHORIC ACID.			Potash soluble in water. Determined as potash.
	Determined as nitrogen.	Equivalent to ammonia.	Availabie.	Insoluble.	Total.	
Guaranteed.	2.05 to 2.9	2.5 to 3.5	8 to 12	2 to 3	10 to 15	2 to 3
Found.	2.36	2.87	9.48	2.93	12.41	1.78
Guaranteed.	....	....	8 to 10	....	8 to 10	6 to 8
Found.	....	....	7.58	0.21	7.79	4.65
Guaranteed.	0.83 to 1.65	1 to 2	7 to 9	....	7 to 9	5 to 6
Found.	0.37	0.45	8.14	1.47	9.61	3.08
Guaranteed.	1 to 1.65	1.25 to 2	9 to 11	1.5 to 2.5	....	6 to 8
Found.	0.88	1.07	8.37	1.3	9.67	5.83
Guaranteed.	1.65 to 2.5	2 to 3	7 to 9	2 to 5	9 to 14	1 to 2
Found.	1.73	2.1	6.76	3.24	10	0.34
Guaranteed.	0.83 to 1.65	1 to 2	11 to 13	2 to 3	13 to 16	1 to 2
Found.	0.88	1.07	11.6	0.72	12.32	1.16
Guaranteed.	2.05 to 2.9	2.5 to 3.5	9 to 10	1 to 2	10 to 12	1.6 to 2.15
Found.	1.3	1.48	6.8	3.48	10.28	0.98
Guaranteed.	2.5 to 3.3	3 to 4	10 to 11	1 to 2	12 to 13	1.1 to 1.6
Found.	1.50	1.93	8.39	3.49	11.88	2.78
Guaranteed.	1.65 to 2.5	2 to 3	8 to 9	1 to 2	10 to 11	2.15 to 2.7
Found.	1.41	1.71	6.46	2.97	9.43	1.27
Guaranteed.	1.65 to 2.5	2 to 3	8 to 9	1 to 2	10 to 11	2.15 to 3.25
Found.	1.52	1.85	7.54	2.51	10.05	1.1
Guaranteed.	1.65 to 2.5	2 to 3	8 to 9	1 to 2	10 to 11	2.15 to 2.7
Found.	1.27	1.54	6.89	2.34	9.23	1.52
Guaranteed.	2.05 to 2.9	2.5 to 3.5	8 to 9	1 to 2	9 to 11	10 to 12
Found.	1.47	1.71	10.33	1.26	11.59	1.83
Guaranteed.	....	....	12 to 15	1 to 2	13 to 17	....
Found.	....	....	13	0.87	13.87	....
Guaranteed.	2.5 to 4.1	3 to 5	....	....	20 to 25	....
Found.	3.02	3.67	17.55	4.97	22.50	....
Guaranteed.	1 to 1.65	1.25 to 2	7 to 9	1 to 2	8 to 11	2 to 3
Found.	2.01	2.44	8.29	3.45	11.74	1.84
Guaranteed.	1 to 1.65	1.25 to 2	7 to 9	1 to 2	8 to 11	2 to 3
Found.	1.28	1.55	8.37	4.19	12.56	2.11
Guaranteed.	0.6 to 1	0.75 to 1.25	9 to 11	2 to 3	11 to 14	1.5 to 2.5
Found.	0.75	0.91	10.66	0.79	11.45	1.81
Guaranteed.	0.83 to 1.65	1 to 2	9 to 11	2 to 3	11 to 14	1 to 2
Found.	1.07	1.3	11.15	1.41	12.56	1.12

REPORT

OF THE

HORTICULTURIST.

S. A. BEACH.

REPORT OF THE HORTICULTURIST.

The nature of much of the horticultural work at this station during 1893, is indicated by the following list of subjects treated in this report:

Vegetables Grown for Exhibition.

Variety Tests of Apples, Grapes, Blackberries, Dewberries, Raspberries and Strawberries.

Strawberry Crosses.

Some Observations on the Life History of Plowrightia morbora (Schw.) Sacc.

Preventing Leaf-Blight of Plum and Cherry Nursery Stock.

Experiments in Preventing Pear Scab.

In addition to the fruits mentioned above, the experimental orchards contain numerous varieties of other fruits, including apricots, cherries, peaches, pears and plums. Careful records of all these varieties have been kept and it is hoped that detailed reports of them may be issued hereafter. Some additions have been made to the collection of native trees and wild fruits in the Arboretum.

New Fruits.— The work of originating new fruits as mentioned on page 530, of this station's 1892 report, has been continued. Several hybrids and crosses were originated during the past year; and many self-fertilized, crossed and hybridized seeds were also secured. The list of these seedlings now under test, includes apples, pears, currants, gooseberries, raspberries, strawberries and grapes. A short account of the work with strawberry crosses is given in the article on strawberry crosses found on subsequent pages.

During the busiest part of the season, the position of assistant horticulturist remained vacant. Mr. Hunn's resignation took effect April first, and the present assistant, Mr. Wendell Paddock, arrived here November first.

The station's extensive correspondence on horticultural topics consumes no inconsiderable portion of the horticulturist's time. He has also prepared the following bulletins:

No. 49, Part I. **Treatment of Potato Scab.**

No. 51. **Some Celery Diseases.**

No. 63. **Some Experiences with Blackberries, Dewberries and Raspberries.**

The first two appeared also in the last annual report, and the last, with some modifications, is included in this report.

Addresses.— The horticulturist was called on to address farmers' clubs at Horsehead and Albion; farmers' institutes at Batavia, Bath, Cortland, Geneseo, Gowanda, Perry, Richford and Ripley, and the Western New York Horticultural Society at Rochester.

Exhibitions.— Throughout the season, fruits and vegetables were sent to the World's Fair, Chicago, Ill. In the latter part of the season, quite extensive displays were also made at the State Fair, Syracuse, N. Y., and at local fairs at Canandaigua, Hornellsville and Geneseo. For the Chicago exhibits, the station received three awards for fruits, one for display of sprayed and unsprayed fruit, and sixteen for vegetables. An account of growing and shipping the vegetables for exhibition is found on subsequent pages.

Greenhouses. — The new greenhouses were completed rather late in the fall. At present they are used for forcing vegetables. Mushrooms are grown under the benches.

Vegetables Grown for Exhibition.

The horticultural exhibit of New York State at the World's fair, Chicago, 1893, was unique in one respect, namely, in the exhibition of fresh vegetables throughout the season. This station took a prominent part in keeping up this exhibit and its contributions brought forth many flattering notices, both from those who had charge of the exhibit at Chicago and from visitors at the fair. The officials of the fair made sixteen awards to this station for its vegetable exhibits.

The plats where the vegetables were grown were a constant source of attraction to visitors throughout the season, several of whom made the journey to the station especially to see the vegetable garden. The rare opportunity was here afforded of seeing a large number of varieties of various kinds of vegetables grown on the same plot of ground. Among the testimonials received the following are presented to show that the efforts of the station were not wholly unappreciated:

WORLD'S COLUMBIAN EXPOSITION,
CHICAGO, ILL., *July*, 5 1893.

DR. PETER COLLIER, *Director:*

MY DEAR SIR.— On my arrival from the East I find the vegetable exhibit in very fine shape. We are the only State making this exhibit, and it is reflecting a great deal of credit on our station for keeping up this exhibit. Mr. Garfield from Michigan, who is judging vegetables at present, says that the New York station is the only one that is really doing the best practical work at the World's Fair. There are some very heavy lettuce growers from Michigan who have been taking notes of the lettuce exhibit and say that they can learn much yet about lettuce culture.

September 2.— I hear from every direction in other States high praise of the work of our station at the fair, and it has been a credit to our State to have it so well represented.

Yours truly.
GEORGE T. POWELL,
Director Horticultural Exhibit of New York State.

CHICAGO, ILL., *July* 9, 1893.

DR. PETER COLLIER, *Director:*

MY DEAR SIR.— I can not praise the work of the station too highly. The exhibit of fresh vegetables from New York State is the only one in the whole exposition, and we are indebted to the station for it. I shall not forget the obligation we owe to the station for its magnificent work.

Yours truly.

E. G. FOWLER,
Ass't Director Hort. Ex. of N. Y. State.

In the *Garden and Forest* of September 20, 1893, Prof. L. H. Bailey, speaking of the vegetable exhibits at the World's Fair said:

> " New York has had the most varied and most interesting display throughout the fair. It is supplied by the State Experiment Station at Geneva, which certainly deserves great praise for its continued supplies of vegetables and fruits."

In the following pages the methods of growing and shipping the vegetables exhibited at the World's Fair are set forth. We will not attempt here to discuss the reasons for the various methods described in the following pages but will simply say that they are the methods used successfully at the station in growing vegetables for exhibition in 1893.

Soil and Cultivation.

The soil on which the vegetables were grown is a stiff clay loam, well tile-drained and fertile. Different plats were plowed about six inches deep, at different times as they were needed for planting. All the vegetables were watered when necessary during the dry season, and the surface of the ground was kept pulverized by frequent cultivation with the Planet Jr. wheel hoe and cultivator. To this thorough cultivation is attributed much of the success in growing good vegetables during the past season.

Earliness, Productiveness and Length of Season.

The different varieties may be compared as to their earliness by noting the date of first shipment as given in the following tables. Occasionally it happened that the very earliest specimens could not be shipped because there were not enough of the variety to make a shipment, but as a rule the tables of shipment afford a fair comparison of the earliness, productiveness of first-class specimens, and length of the shipping season. Shipments of each vegetable were commonly made as long as it continued to produce good market specimens.

It should be noted that the first shipment of early lettuce and radishes was delayed several days because of instructions from Chicago stating that no shipments should be made till further notice. With the above exceptions the vegetables were shipped as soon as they were in good marketable condition. With peas, lettuce, cress, corn and other vegetables a succession of fresh vegetables was secured throughout the season by making successive plantings.

No effort was made at any time to have the vegetables ready for shipment before their natural season of maturity in this locality.

Beans.

Bush beans.— The soil on which the bush beans were grown was given a light dressing of well rotted stable manure before being plowed. After being plowed it was thoroughly pulverized and made very mellow. The seed was sown in drills two feet apart. The beans were dropped about two inches apart in a furrow made with the rake or hoe, varying in depth from one and a half to two inches, according to the size of the seed. The smaller seeds were planted more shallow than were the varieties of large sized beans. The seed was covered by pressing the soil firmly against it with the feet. The operation was performed by putting the feet close together on each side of the open drill and with short steps tramping the entire length of the drill, thus crowding the fresh dirt upon the seeds, then returning the full length of the drill, tramping on top of the covered seed. Failure to secure a good stand not only with beans but also with other seeds sometimes results when the seed is covered loosely, because the soil around the seed is allowed to become dry and hard. Pressing of the soil firmly about the seed may seem like a very unimportant matter, but it is really very important. The soil may be made sufficiently firm by the method above described. This method was used here with all kinds of seed planted in drills, even with lettuce and onions.

About a week after the beans came up they were given a light dressing of a mixture of wood ashes and finest bone meal, containing one measure in volume of the bone meal to five of ashes. This was sprinkled near the plants and cultivated in with the Planet Jr. Care was taken during the season not to cultivate the beans when they were wet with dew or rain, in order that the spores of the anthracnose might not be distributed over the plants in this way. The anthracnose causes the spotting, or rusting as it is frequently called, of the pods, stems and leaves.*

The beans were packed for shipment in boxes twelve inches long by six inches wide and three inches deep, as shown in plate I reproduced from a photograph. These boxes were of three-eighths inch stuff, except the ends, which were of half-inch stuff. Three-eighths inch strips were also fastened on top of the boxes. The boxes were shipped in open crates, each of which held twenty-four.

A second crop of beans was sown after the first crop of lettuce, thus securing a second crop on the same soil. The crop of late beans from this ground was fully equal in quantity and quality to the crop from seed planted in the spring. The following is a list of the varieties shipped:

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* The manner in which the anthracnose spreads from diseased to healthy foliage and pods is set forth quite fully in Bulletin 48 of this Station, on "Some Bean Diseases," page 311.

Bush Beans.

NAME.	When planted.	When shipped.	Remarks.
Best of All	May 10 July 25	July 5, 11, 20, 28 Sept. 26, Oct. 3	Good cropper; compact grower; long season; long green pods.
Blue Podded Butter	May 10 July 25	July 11, 20, 28 Sept. 26, Oct. 3	Season long; compact grower; good cropper; purple flower and purple tinge to leaves and pods; pods large and long.
Boston Small Pea	May 10 July 25	July 11, 28 September 26	Good cropper; vigorous, half climbing; long season; very productive; narrow, short, green pods.
Burpee's Perfection Wax	May 10 July 25	July 5, 11, 20 Sept. 26, Oct. 3	Not as good cropper here as some others of its class; pods yellow, long and flat; attractive in appearance.
Champion Bush	May 10	July 28	Not a satisfactory cropper here; very compact bush; broad, medium long pod.
China Red Eye	May 10 July 25	July 5, 11, 20, 28 October 3	Compact grower; very productive; long season; large, moderately long, green pod.
Dwarf German Black Wax	May 10 July 25	July 5, 11, 20, 28 Sept. 26, Oct. 3	Fine cropper; compact growth; long season; round, long, yellow pods.
Dwarf Golden-Eyed Wax	May 10 July 25	July 5, 11, 20, 28 Sept. 26, Oct. 3	Vigorous compact grower; very productive; long season; large yellow pods; thicker than those of Dwarf Golden Wax.
Dwarf Golden Wax	May 10 July 25	July 5, 11, 20, 28 Sept. 26, Oct. 3	Compact; vigorous grower; long season; compared with Flageolet Wax it has broader and shorter pods, of an attractive clear yellow color.
Early Mohawk	May 10 July 25	July 5, 11, 20, 28 Sept. 26, Oct. 3	Quite similar to Early Yellow Six Weeks, but is more productive and has better shaped pods.
Emperor William	May 10 July 25	July 5, 11, 20 Sept. 26, Oct. 3	Long season; good for general crop; broad, flat, long green pods.
Extra Early Refugee	May 10 July 25	July 5, 11, 20, 28 Sept. 26, Oct. 3	Vigorous grower; round, green, medium long pod; good general crop bean.
Extra Early Red Speckled Valentine	May 10 July 25	July 5, 11, 20, 28 Sept. 26, Oct. 3	Long season; round, green, moderately long pod; productive; one of the best of its class.
Early Yellow Six Weeks	May 10 July 25	July 20, 28 Sept. 26, Oct. 3	Very vigorous; good cropper; long season; long flat green pod.
Flageolet Wax	May 10 July 25	July 5, 11, 20 Sept. 26, Oct. 3	Long season; vigorous grower; attractive, long, flat, narrow, clear yellow pods; very productive and satisfactory as grown here.

Bush Beans—(*Concluded*).

NAME.	When planted.	When shipped.	Remarks.
Goddard	May 10	July 20, 28	Very productive; very long, flat, green pods.
Horticultural	May 10 July 25	July 5, 11, 20 Sept. 26, Oct. 3	Good cropper; long season; compact growth; short, flat, green pods
Improved Golden Wax	May 10 July 25	July 5, 11, 20 Oct. 3	Good cropper; long season; productive; pods frequently tinged with green; quite similar to Improved Rust Proof Golden.
Improved Rust Proof Golden Wax	May 10 July 25	July 5, 11, 20 Sept. 26, Oct. 3	Not rust proof; handsome pod, not quite so long as Flageolet Wax.
Kidney Wax	May 10 July 25	July 5, 11, 20 Sept 26, Oct. 3	Good cropper; compact grower; long, flat, yellow pods.
New Black-Eyed Wax	May 10 July 25	July 5, 11, 20 Sept. 26, Oct. 3	Long season; moderately long, thick yellow pod; not first-class in pod or productiveness as grown here.
New Prolific German Black Wax	May 10 July 25	July 5, 11, 20, 28 Sept. 26, Oct. 3	Long season; moderately long, round, yellow pods.
New Prolific Tree	May 10		Vigorous half climber; small leaves; did not produce well till very late in the season; should be sown quite thin on account of its vigorous growth.
Rufugee	July 25	Sept. 26	Good cropper; vigorous dark green foliage; medium, round, mottled green pod.
Round Yellow Six Weeks	May 10 July 25	July 5, 11 Sept. 26, Oct. 3	Good cropper; moderately long season; moderately long, thick, pale green pod; not as good as others of the same class that ripen at the same season.
Wardwell's Kidney Wax	May 10 July 25	July 5, 11, 20 Sept. 26, Oct. 3	Good cropper; long season; long, flat, yellow pod; equal to any of its class as grown here.
White Marrowfat	May 10 July 25	July 20 Oct. 3	Short season; productive; moderately long, flat, thick, green pods.
Yosemite Mammoth Wax	May 10 July 25	July 11, 20, 28 Sept. 26	Good cropper; moderately productive; long season; long, curled, round yellow pods; vigorous; equal to any of its class as a late variety.

Bush lima beans.— The soil for the bush limas was prepared in the way described for common bush beans and the culture and fertilization throughout the season were the same with both, except that the lima plants were thinned to about a foot apart in the row. They were shipped in the same kind of boxes as were the common bush beans, except that a small trough at one end of the box was filled with shelled beans after the manner shown with the peas in plate II. The following varieties were shipped :

Bush Lima Beans.

NAME.	When planted.	When shipped.	Remarks.
Burpee's Bush Lima	May 10	August 21, 28	Did not grow well or produce well here this year. Was shipped but twice.
Henderson's Bush Lima	May 10	August, 12, 16, 21, September 13	Good cropper. Beans of larger size than those of Jackson's Wonder. This and Jackson's Wonder were shipped twice before any other Limas were ready for picking.
Jackson's Wonder	May 10	August 12, 16, 21, 28, September 13	Good cropper. Compared with Henderson's Bush Lima, the plant is more vigorous and the bean is somewhat smaller than the Henderson and not so good in color. When very young the bean is white, but it soon becomes mottled with purple.
Kumerle Dwarf	May 10	August 21, September 13, 26	Inclined to climbing habit of growth. The bean is very large for a dwarf variety. Did not produce well this year (1893).
Thorburn's Dwarf	May 10	August 21, 28, September 13	A very fine bean, but not so productive as Henderson's or Jackson's Wonder; good white color.

Pole lima beans.— For the pole limas the ground was not manured before plowing, but after it was plowed and thoroughly harrowed, holes were opened four feet apart each way. Two shovelfuls of well rotted stable manure were put into each hole and covered with the soil which came from the hole. In this soil the beans were planted two inches deep, six to each hill. Four plants were allowed to grow for each hill. The cultivation, fertilizing and packing were done in the same way as with the bush limas. Tobacco dust was applied to the leaves when necessary to prevent injury from plant lice. The following varieties were shipped:

Pole Lima Beans.

NAME.	When planted.	When shipped.	Remarks.
Challenger	May 25	September 13, 26	Vigorous, fairly productive; small pod; young beans are green.
Early Black	May 25	September 13, 26	Very productive; vigorous; medium in pod and bean. Bean white near the eye, otherwise very dark purple; as productive as New Willow Leaf.
King of the Garden	May 25	September 13, 26	Vigorous, fairly productive; long pod; a fine, large, white bean; ranks about with Large White.
Large White	May 25	September 13, 26	Vigorous; very large white bean; not so productive as New Willow Leaf.
New Willow Leaf	May 25	September 13, 26	Good cropper; medium size pod; very narrow, long leaves.
New Extra Early	May 25	September 13, 26	Large pod and bean; beans green when young; vigorous; not so productive as Large White.
Small Lima	May 25	September 13	Vigorous; medium pod; medium white bean; ranks about with Large White in productiveness.

Beets.

For beets the soil was prepared and the seeds planted in the manner described for bush beans, except that the seed was covered only an inch deep. The drills were eighteen inches apart. Care was taken to tramp the dirt firmly around the seed as described on page 547. When the plants were still very small they were thinned to eight inches apart in the row. They were then fertilized with a mixture of wood ashes and bone meal as described for beans. See p. 547. The surface of the soil was kept mellow by frequent cultivation. When ready for market the beets were pulled and tied in bunches of six each. The tops were then cut off and the lower half of one beet in each bunch was usually cut away so as to show the color and markings of the root in cross section. This was not done with the bunches shown in plate II. When shipped the bunches were simply packed firmly in open crates. The following is a list of varieties shipped:

Beets.

NAME.	When planted.	When shipped.	Remarks.
Bastian's Extra Early Red Turnip	May 12, Aug. 9	July 17, 22, 27, Aug. 2, 8, 15, 28, Sept. 13.	A good crimson beet, uniform in shape.
Bastian's Half Long Blood Red	May 12, Aug 9	July 22, 27, Aug. 2, 8, 15, 28, Sept. 13.	Well described by its name.
Burpee's Early Turnip	May 12, Aug. 9	July 17, 22, 27, Aug. 2, 8, 15, 28, Sept. 13.	Similar to Burpee's Improved Blood Turnip in shape; of lighter color; regular in form.
Burpee's Improved Blood Turnip	May 12, Aug. 9	July 17, 22, 27, Aug. 2, 8, 15, 28, Sept. 13.	Color dark; desirable size.
Columbia	May 12	July 17, 22, 27, Aug. 2.	A free grower; handsome dark color.
Dewing's Improved Blood Turnip	May 12, Aug. 9	July 17, 22, 27, Aug. 2, 8, 15, 28, Sept. 13.	Not a blood turnip, too light in color; has white rings in the flesh.
Dewing's Turnip	May 12, Aug. 9	July 17, 22, 27, Aug. 2, Sept. 13	A blood turnip, but not so dark as Burpee's Improved Blood Turnip.
Early Blood Red Turnip	May 12, Aug. 9	July 17, 22, 27, Aug. 2, Sept. 13.	Very dark rich color.
Early Bassano Turnip	May 12	July 22, 27, Aug. 2, 8, 28.	Very handsome; very light color.
Early Yellow Turnip	May 12, Aug. 9	July 17, 22, 27, Aug. 2, 28, Sept. 13.	Free grower; orange rings in flesh; dark yellow skin; a beautiful beet.
Early Egyptian Turnip	May 12	July 17, 22, 27, Aug. 2, 28.	Old variety and one of the best.
Edmund's Extra Early Blood Turnip	May 12, Aug. 9	July 17, 22, 27, Aug. 2, 8, 15, 28.	Hardly dark-colored enough to be called a blood turnip; color light crimson.
Egyptian Blood Turnip	May 12, Aug. 9	July 17, 22, 27, Aug. 2, Sept. 17.	Darker than Early Egyptian Turnip.
Henderson's Pineapple	May 12, Aug. 9	July 27, Aug. 2, 28, Sept. 13.	Very dark color; long.
Long Smooth Blood Red	May 12, Aug 9	July 27, Aug. 2, 8, 25, Sept. 13.	Well described by its name.
Mitchell's Perfected Dark Red	May 12, Aug. 9	July 17, 22, 27, Aug. 2, 8, 15, 28, Sept. 13.	A turnip beet; not very dark.
New Eclipse	May 12	July 17, 22, 27, Aug. 2, 8.	A good blood beet.

Swiss Chard.—The Swiss Chards were grown in the same way as were the beets and were handled and packed in the same way, except that the tops were tied rather loosely in two or three places to keep them from being broken. The varieties named below all did well and were beautiful in appearance when ready for market. Their color is suggested by their names.

Swiss Chard.

NAME.	When planted.	When shipped.
Large Ribbed Brazilian Scarlet	May 12 Aug. 9	July 22, 27, Aug. 2, 15, 28. Sept. 14, Oct. 3.
Large Ribbed Silver	May 12 Aug. 9	July 22, 27, Aug. 2, 15, 28. Sept. 14, Oct. 3.
Large Ribbed Yellow Brazilian	May 12 Aug. 9	July 22, 27, Aug. 2, 15, 28. Sept. 14, Oct. 3.

Carrots.

The ground was prepared for carrots in the manner described for bush beans (see p. 547), the drills were made eighteen inches apart and the seed was covered an inch deep. When the plants very still very small they were thinned to six inches apart in the row. They were fertilized in the same manner as described for bush beans. See p. 548. When ready for market they were pulled and tied in bunches of six carrots each, the tops were cut off and the bunches were packed firmly in open crates. The following is a list of varieties shipped:

Carrots.

NAME.	When planted.	When shipped.	Remarks.
Chautenay	May 9	July 22, 27, Aug. 2, 8, 15, 28, Sept. 13	
Coreless Long Red	May 9	July 22, 27, Aug. 2, 8, 15, 28, Sept. 13	
Danver's Half Long Orange	May 9	July 22, 27, Aug. 2, 8, 15, Sept. 13	
Danver's Orange	May 9	July 27, Aug. 2, 8, 15, 28	Long.
Early Very Short Scarlet, Vick's	May 9	July 22, 27, Aug. 2, 8, 15, 28	Short, thick; very good.
Early French Short Horn, Burpee's	May 9	July 22, 27, Aug. 8, 15	Quite short; good color.
Early French Short Horn, Vick's	May 9	July 22, 27, Aug. 2, 8, 15	Identical with Burpee's above.
Half Long Scarlet Stump Rooted, Burpee's	May 9	July 22, Aug. 2, 8, 15, 28, Sept. 13	
Half Long Scarlet, Vick's	May 9	July 22, 27, Aug. 2, 15, Sept. 13	
Improved Long Orange	May 9	July 27, Aug. 2, 8, 15, 28	
Large White Belgian	May 9	July 27, Aug. 2, 8, 15, 28	A novelty in appearance; poor color.
Large Yellow Belgian	May 9	July 27, Aug. 2, 8, 15	Peculiar bright orange color; a novelty.
Large White Vosges	May 9	July 22, 27, Aug. 2, 8, 15, 28	Has a poor color for a market carrot.
Long Red Altringham	May 9	July 27, Aug. 2, 8, 15, Sept. 13	Excellent cropper; an old and good market variety.
Oxheart	May 9	July 22, 27, Aug. 2, 8, 15	Color uniform from the center nearly to the rind.
Saint Vallery	May 9	July 27, Aug. 2, 8, 15, 28, Sept. 13	Beautiful color; long, straight, with wrinkled surface.

Corn.

For corn the ground was prepared and manured in the same way as for pole beans. See p. 553. Cleancultivation was given throughout the season. A mixture of wood ashes and bone meal was applied five or six times during the season, the total amount used being at the rate of about three hundred pounds per acre.

Sweet corn.—The sweet corn was husked and packed on excelsior in boxes similar to those described for beans but twice as wide. See p. 548. Three-eighths inch slats were fastened over the tops of the boxes after they were filled and the boxes were then packed in the same kind of crates as those used for beans. The following is a list of the varieties shipped:

Sweet Corn.

NAME.	When planted.	When shipped.	Remarks.
Amber Cream	May 23	August 16, 22, 31, September 5	Moderate cropper here; medium size; twelve rowed; late.
Black Mexican	May 23	August 16, 22, 31, September 5	Medium size; eight rowed; broad, flat, black kernel; not a good cropper; late.
Chicago Market	May 23	August 16, 22, 31	Medium size cob; large kernel; eight rowed; fair cropper.
Cory	May 23	August 1, 7	Good extra early sort.
Country Gentleman	May 23	August 31, September 5, 13	Fairly vigorous; medium size; good cropper; very late; small kernels set irregularly instead of in rows. Shoe-peg class.
Crosby's Early Twelve Rowed	May 23	August 12, 16, 31	Fair cropper; medium size.
Early Eight Rowed Sugar	May 23	August 16, 22, 31	Medium size; large kernel; very sweet; fair cropper.
Early Minnesota	May 23	August 12, 16, 22, 31	Good cropper; medium size; eight rowed; large kernels.
Egyptian	May 23	August 22, 31, September 5, 13	Ear above medium size; twelve rowed; medium size kernels; good cropper.
Extra Early Adams	May 23	August 1, 7, 12	Medium size; moderate cropper; fourteen rowed.
First of All	May 23	August 1, 7	Small size in ear and stalk; eight rowed; not as good a variety as other extra early sorts tested this season.
Golden Nugget, Vick's	May 23	August 22, 31	Beautiful yellow color in roasting ear stage; very sweet: moderate cropper; stalk below medium size; cob and kernel medium size.
Henderson's Red Cob Evergreen	May 23	August 31, September 5, 13	Very large ear; spiral or irregular rows; shoe-peg kernels; good cropper.
Hickox Improved	May 23	August 22, 31, September 13	Good cropper; fine large ear; medium size kernel; one of the best.
Improved Ruby	May 23	August 22, 31, September 13	Good cropper; medium ear; large kernel; red cob and husk.
Livingston New Silver Coin	May 23	August 31, September 5	Good cropper; vigorous; large ear; medium kernel.
Mammoth Early	May 23	August 31, September 5, 13	Twelved rowed; medium size; good cropper; a late variety.
Marblehead Early	May 23	August 1, 7	Small in stalk and cob; large kernel; eight rowed.

Mammoth Late	May 23	August 31, September 5, 13	Large ear; medium kernel; twelve rowed; vigorous; good cropper.
Mammoth Sugar	May 23	August 22, 31, September 5, 13	Large stalk; medium kernel; very sweet; good cropper.
Moore's Early Concord	May 23	August 16, 22	Eight rowed; below medium size; medium kernel; not a good crooper.
Ne Plus Ultra	May 23	August 31, September 13	Small ear; shoe-peg kernels; medium stalk; good cropper.
New Early Champion	May 23	August 22	Small in stalk and ear; ten rowed; poor cropper and much inferior to Old Colony, as grown here.
Old Colony	May 23	August 22, September 5, 13	Medium size ear and kernel; sixteen rowed; moderately strong grower.
Perry's Hybrid	May 23	August 1, 7, 12, 22	Large kernel; twelve rowed; medium cob and stalk.
Potter's Excelsior	May 23	August 22, 31, September 13	Eight rowed; large kernel; medium cob; vigorous; good cropper.
Shaker's Early	May 23	August 7, 12, 22, 31	Medium size; large kernel; twelve rowed; vigorous; a good early sort.
Stabler's Extra Early	May 23	August 22, 31, September 13	A good late sort here; medium size in kernel and ear; good cropper.
Stabler's Pedigree	May 23	August 22, September 6, 13	A good late variety; fine large ear and kernel; twelve rowed; good cropper; vigorous.
Stowell's Evergreen,	May 23	August 31, September 6, 13	Vigorous grower; good cropper; medium kernel; an old well known variety
Triumph	May 23	August 22, September 6, 13	Cob and kernel above medium size; strong grower.
Ziz Zag Evergreen	May 23	September 5, 13	Very late; medium cob; small shoe-peg kernel; moderately strong grower; good cropper.

Pop corn.— Pop corn was grown and shipped in the manner just described for sweet corn. The following varieties were shipped, namely:

Amber Rice,
Golden Tom Thumb,
Mapledale Prolific,
Queen Golden,
Silver Lace.

Cress.

For cress the soil was given a liberal dressing of well rotted stable manure and the manure was plowed under about six inches deep. It was thoroughly harrowed and the seed covered about an inch deep in drills eight inches apart. The ground was kept mellow by frequent cultivation with a Planet Jr. wheel hoe. The tops were cut when they were three or four inches long, and shipped in boxes of the same kind as those used for sweet corn. See p. 559. The tops were not tied in bunches but were simply packed firmly in the box till it was filled. The top of the box was then covered with three-eighths inch slats. The boxes were shipped in crates in the same manner as were the beans.

By sowing every two weeks a succession of crops may be grown throughout the season. It makes an excellent substitute for water cress and is easily grown in any ordinary garden soil. The following varieties were shipped:

CRESS.

NAME.	When planted.	When shipped.	Remarks.
Extra curled	Aug. 10.	September 13.....	Fine curled leaf, somewhat resembling parsley in appearance; vigorous; good cropper; easily grown in any fertile soil.
Australian	Aug. 10.	September 8......	Resembles watercress in general appearance more than does the preceding; large broad leaf slightly curled; vigorous; good cropper; easily grown; not as delicate in appearance as the preceding.

Cucumbers.

The cucumbers were started in frames where they could be protected from heavy rains and cold nights. The frame was filled with inverted sod cut so that the surface of each sod was six inches square. A hole was made about half an inch deep in the center of each square, and in this hole six seeds were planted and the whole bed covered about a half inch deep with fine soil, thus making the seeds about an inch deep. The seeds were planted May 20 and the plants were put in the open ground June 16.

After the seed was sown the bed was not watered till the plants had come up. With melons and cucumbers the seed is quite liable to rot if the ground is watered before the plants come up. When the plants were transplanted each sod with the plants contained in it was taken from the frame and set in a hill prepared in the manner described for pole lima beans. See p. 553. The plants were watered and shaded for a week or ten days, till they became established in their new location. Three plants were allowed to remain for each hill. They were dusted plentifully with tobacco powder whenever it seemed necessary to protect them from aphis and other delicate insects. The tobacco powder was applied when the plants were wet. Beginning two or three weeks after the plants were set in the open ground they were given every week an application of liquid manure diluted with an equal quantity of water. This was applied at the rate of a half gallon to the hill for each application. The vines were pinched back at the third joint and as fast as the laterals appeared throughout the season they were treated in the same manner. The surface of the soil was kept mellow the same as with the other crops previously mentioned. After the vines began to bear they were given a solution of nitrate of soda. An ounce of the nitrate of soda was dissolved in a gallon of water and each hill was given about a quart of this solution two or three times during the season. They were packed in boxes made of the material described for bean boxes on p. 548; the size of the boxes varied according to the length of the cucumbers. The following is a list of the varieties shipped :

Cucumbers.

NAME.	When planted.	When shipped.	Remarks.
Arlington	May 20	July 28, August 1, 7, 9, 12, 16, 21, 28, September 5, 13, 26	White spine; vigorous; productive; fine dark color; good size.
Carter's Champions	May 20	August 7, 9, 12, 16, 21, 28, September 13, 26	English frame; dark green; white spine; good cropper; one of the best large varieties grown here this season in the open ground. Some specimens were one and one-half feet in length.
Carter's Model	May 20	July 28, August 16, 21, 28, September 13	Not a good cropper here; vigorous; white spine; longer fruit than Carter's Champion but not so hardy a variety.
Chicago Pickling.	May 20	July 28, August 1, 7, 12, 21, 28, September 5, 13	Not vigorous; very short; for pickling only; black spine; moderate cropper; not satisfactory on our soil.
Chinese Long Green	May 20	July 28, August 1, 7, 12, 21, 28, September 5, 12, 26	Vigorous; long; dark green: black spine; good cropper.
Early Frame	May 20 June 16	August 7, 12, 16, 21, 28 September 5, 13. 26	Black spine; not very productive; not vigorous; not a success out doors on our soil; moderate size.
Early Green Cluster	May 20	August 7, 16, 21	....
Early Green Prolific	May 20	July 28, August 1, 12, 21	Black spine; short fruit; a pickling variety; not so productive as Early Russian.
Early Russian	May 20	July 28, August 1, 7, 12, 16, 21, 28, September 5, 13, 26	Productive; not vigorous here; short fruit; a pickling variety; black spine.
Extra Long Green Prickly	May 20	July 28, August 16, 28, September 5	....
Extra Long White Spine	May 20	July 28, August 1, 7, 9, 12, 16, 21, 28, September 5, 13, 26	Well described by its name; good cropper; as good as any variety of its class tested here this season.
General Grant	May 20	August 1, 9, 12, 16, 21, 28, September 13, 26	An English frame variety; white spine; fine shape; some specimens one and one-half feet long.
Giant of Arnstadt	May 20	July 28, August 1, 7, 12, 16, 21, 28, September 5, 13, 26	Long fruit; black spine; dark green; vigorous; good cropper.
Giant Pera, Burpee's	May 20	July 28, August 1, 7, 9, 12, 16, 21, 28, September 5, 13, 26	Rough with black spines; large, long fruit; good cropper.
Hall's Forcing White Spine	May 20	August 7, 12, 16, 21, 28, Sept. 13, 26	Good shape; vigorous; good cropper; dark green.

Japanese Climbing	May 20	August 1, 7, 9, 12, 21, 28, Sept. 5, 26	Good color; fruit nearly one foot long; vigorous.
Livingston's Evergreen	May 20	July 28, August 7, 12, 16, 21, 28, September 5, 13, 26	First class; moderately long; black spines; vigorous; productive.
Long Green Southgate	May 20	July 28, August 7, 12, 16, 21, 28, September 5, 13, 26	Vigorous grower; moderately productive; some specimens one foot long; an English frame variety.
London Long Green	May 20	July 28, August 1, 7, 9, 16, 21, 28, September 5, 13, 26	Fruit from eight to ten inches long; black spines.
New Giant White	May 20	July 28, August 12, 18, 21, 28, September 5, 26	White spine; white flesh; fruit over one foot long; vigorous; good cropper.
New Paris Pickling	May 20 June 16	July 28, August 1, 7, 9, 12, 21, 28 September 5, 26	Very long for pickling; rough, black spine; good cropper; vigorous.
Nichols' Medium Green	May 20	July 28, August 7, 9, 12, 21, 28, September 5, 13, 26	Black spine; medium size; dark green fruit; moderate cropper.
Peerless White Spine	May 20	July 28, August 1, 7, 9, 12, 16, 21, 28, September 5, 13, 26	White spine; vigorous; first-class cropper; the best of its class tested this season.
Serpent	May 20	July 28, August 1, 7, 12, 21	Fruit smooth, nearly white; foliage resembles the cantaloupe more than the cucumber; some specimens of this novelty were over two feet long; it is said to grow to a length of six feet, and the seed catalogue calls it fair in quality.
Siberian	May 20	July 28, August 7, 9, 16, 21, Sept. 5, 26	White spine; white skin; vigorous; productive.
Thorburn's New Everbearing	May 20	July 28, August 1, 7, 12, 21	Very short; a pickling variety; black spine; not vigorous; unproductive here.
West India Gherkin	May 20	July 28, August 28, September 13, 26	
Westfield's New Improved Chicago Pickle	May 20 June 16	July 28, August 1, 7, 9, 12, 16, 21, 28 September 5, 13, 26	First-class; short black spine; vigorous; productive.
White Pearl	May 20	August 7, 16, 21, September 5, 26	Good cropper; vigorous; white color.

Egg Plant.

The egg plants were started in flats in the hot-bed. When the plants were about two and a half inches high they were transplanted to three-inch pots and transferred to frames, that they might become hardened before transplanting to the open ground. They were transplanted somewhat later than the tomatoes. They were set in the open ground in rows ten feet apart and the plants were two feet apart in the row. The ground was prepared in the manner described for pole lima beans. See p. 553. The plants were knocked out of the pots and the ball of earth surrounding the roots was partially crushed so as to spread the roots in transplanting. The plants were set in the ground so that the seed leaf came at the surface of the soil. They were then watered and shaded for about a week till they became established in the soil. A mixture of wood ashes and bone meal was applied five or six times in the manner described for bush beans on p. 548, the total amount applied during the season being about three hundred pounds per acre. Tobacco dust was applied whenever necessary to keep off the plant lice and other injurious insects. The only variety grown was the Improved New York Purple which is one of the best kinds for this section. It was shipped Sept. 13 and 26.

Gourds.

The gourds were handled in the manner described for cucumbers on page 562. The Nest Egg gourd was extremely productive, nearly white, ovate and from two to three inches in shortest diameter. It was shipped Aug. 7, 12, 16, 18, 22, 30, Sept. 1, 5 and 13.

Lettuce.

The soil for lettuce was prepared in the manner described for bush beans on p. 547; and the seed was covered about half an inch deep in drills eighteen inches apart. The soil was packed firmly over the seed as noted on p. 547. When the plants were about an inch high they were thinned to a foot apart in the row. The plants removed in thinning were transplanted, and being thus retarded their season was prolonged for about three weeks. It was necessary to water the transplanted plants every day for a week until they were well established. By making another sowing as soon as the plants of the preceding crop are an inch high a constant supply of lettuce may be secured through the season.

After the plants began to head they were given an occasional application of liquid manure diluted with an equal quantity of water. The surface of the soil was kept mellow throughout the season.

The cos varieties were blanched by tying the outside leaves around the head when it was about half developed. They were shipped in boxes sixteen inches by twenty-four inches by six inches deep, made of three-eighths inch stuff for top, side and bottom, and inch stuff for the ends. The roots were packed in these boxes in damp sphagnum and the outer leaves were cut away so as to expose the blanched heads. The other kinds of lettuce were packed in a similar manner with their roots in damp sphagnum. The boxes were shipped in open crates, each crate holding six boxes of lettuce. The following is a list of the varieties shipped:

Lettuce.

NAME.	When planted.	When shipped.	Remarks.
All Year Round	April 27	June 27, July 7	An old variety and a good one; a cabbage lettuce; none grown here this season excelled it; free grower.
Black Seeded Butter	April 27 July 21	June 27, July 7 September 13, 26	A cabbage sort; much like All Year Round.
Black Seeded Simpson	April 27 July 21	June 29, July 3, 13 September 13, 26, October 6	One of the old varieties; a curled sort. Not so long season as Henderson's. Similar to Boston Curled as grown here.
Black Seeded Tennis Ball	April 27 July 21	June 27, July 7	A cabbage lettuce, much like All Year Round.
Blond Blockhead	April 27 July 21	June 29, July 3, 13, 20 September 13, 26	First-class curled; rather pale green foliage; first early, yet long season.
Boston Curled	April 27		Free grower; runs quickly to seed.
Buttercup	April 27 July 21	June 21, July 13 September 13, 26, October 6	A variety of cabbage lettuce with attractive golden color; free grower; first early.
California Cream Butter	April 27 July 21	June 27, July 7, 13 September 13, 26, October 6	A Dutch cabbage lettuce; slightly shaded with brown; a first-class sort.
Deacon	April 27 July 21	July 1, 13 September 13, 26	Smooth leaf, with silvery tinge; very compact cabbage; similar to Imperial White Cabbage, but better and more vigorous as grown here.
Denver Market	April 27 July 21	July 20 September 26, October 6	A late and long season lettuce; very tender foliage showing tendency to blight on leaf margin; handsome, pale, glossy green, curled leaf.
Early Curled Silesia	April 27	June 27, July 3, 7, 13	A curled lettuce; free grower.
Early Curled Simpson	April 27	June 27, July 3, 7, 13	An old variety and one of the best of the curled sorts.
Early Prize Head	April 27	June 27, July 3, 7	Dwarf, beautiful curled; scarlet tinged; first-class for garnishing.
Grand Rapids	April 27	June 29, July 13, 20	Extra curled; pale green; free grower; dwarf; long season; one of the best of the curled grown here this season.
Green Fringed	April 27		Runs to seed very early; of no use as grown here.

Gold Nugget	April 27 July 21	June 27, July 7, 13 September 13, 26	Very similar to, if not identical with, All Year Round.
Hanson	April 27 July 21	June 29, July 3, 13, 20 September 13, October 6	Curled; not so pale as some, but of good light color; a free grower; long season; next to Henderson's as a late sort as tested here this season.
Hard Head, Burpee's	April 27 July 21	June 27, July 7 September 13, 26, October 6	A brown cabbage; first class; equal to the best varieties.
Henderson's New York	April 27 July 21	June 29, July 3, 13, 20 September 13, 26, October 6	A curled cabbage; silvery green foliage; a good general purpose lettuce; free grower; the best sort for long season tested here this year.
Hittinger's Belmont	April 27		Gives no satisfaction on our soil; one of the first to run to seed.
Hubbard's Market, Burpee	April 27		A cabbage; good, but not first-class as grown here.
Hubbard's Market, Vick's	April 27	June 29, July 7, 13	A cabbage; distinct from the last named as grown here.
Imperial White Cabbage	April 27	June 29, July 1	Smooth leaf; compact cabbage; free grower.
Marblehead Mammoth	April 27 July 21	July 3 September 13, 26	A good late, long season, curled cabbage; margin of foliage slightly tinged with reddish brown.
New Balloon	April 27 July 21	June 29, July 13 September 13, 26	A good lettuce, but not first class on our soil; one of the cos varieties
New Iceberg	April 27	June 29, July 3, 7	Very handsome curled cabbage; paler foliage than Henderson's New York, and not so compact; a free grower.
Onondaga	April 27 July 21	June 27, July 7 September 13, 26, October 6	A beautiful dwarf; leaves tipped with dark scarlet; extra curled garnishing; good grower.
Paris Green Cos	April 27 July 24		Fairly good; did about as well as the Paris White Cos.
Paris White Cos	April 27 July 21	June 29, July 13 September 13	An old and well-known variety; does not do well on our soil.
Perpignan	April 27 July 21	July 20 September 13, 26	A brown Dutch cabbage variety; good of its class.
Philadelphia Early White	April 27		Cabbage; not satisfactory here; ran to seed before it could be handled.
Premium Cabbage, Vick's	April 27 July 21	July 1 October 6	Not uniform and not first-class as grown here.

Lettuce — (*Concluded*).

NAME.	When planted.	When shipped.	Remarks.
Prize Head	April 27	June 27, July 7	A handsome curled dwarf; deep scarlet tip, darker than Onondaga; did not head.
Satisfaction	April 27 July 21	June 27, July 1, 7 September 13, October 6	A white cabbage lettuce; compact; good habit.
Silver Ball, Burpee's	April 27 July 21	June 27. July 7, 13 September 13, 26, October 6	A cabbage lettuce; much like All Year Round, but with slightly deeper tinge to the foliage.
Stone Head Golden Yellow	April 27		A cabbage sort; unsatisfactory.
Thick Head Yellow	April 27 July 21	June 29, July 7 September 12	A cabbage; neither uniform nor compact; not first-class as grown here.
Tomhannock, Burpee's	April 27	June 27, July 7	A very handsome lettuce; curled; deep scarlet margin.
Trianon	April 27	June 29, July 13, 20	A cos; not so good on our soil as it should be; long season, being the only cos that stood till the last shipment of summer, July 20.
White Cabbage	April 27	June 27, July 1, 7	An old variety and one of the best; very compact; free grower.
Yellow Seeded Butter	April 27 July 21	July 1 September 13, 26, October 6	Not uniform; not up to standard excellence as grown here.

Melons.

The melons were started on inverted sod and transplanted to hills in the manner described for cucumbers on p. 562, and were given throughout the season the line of treatment there set forth. When ripe they were packed firmly in excelsior and shipped in open crates. The following is a list of the varieties shipped.

Muskmelons.

NAME.	When sown.	When shipped.	Remarks.
Acme	May 26	September 26	Round, ribbed, netted; fair cropper here.
Aly's Seedling	May 26		Yellow skin, netted, medium size; not a good cropper here.
Banana Citron	May 26	September 13, 26	Yellow fleshed, blending from green to salmon; skin straw color, free from netting; a good cropper; fair quality.
Banquet	May 26	September 13, 26	Medium size, very flat at both ends; beautifully netted; excellent quality; deep flesh, of dark salmon color; not a good cropper here this season.
Champion Market	May 26	September 13, 26	Small size; good cropper; round, ribbed and netted; reddish flesh.
Chicago Market	May 26		Early; large and uniform; thickly netted skin; small seed cavity; deep green flesh, juicy and delicious; free from rot; good cropper.
Chicago Nutmeg	May 26	September 13, 26	A first class variety; large, deep ribbed, netted.
Emerald Gem, Thorburn	May 26	September 13, 26	Small, smooth, ribbed, dark green skin; orange flesh, very sweet, excellent flavor; extra early.
Emerald Gem, Burpee	May 26	September 13, 26	Skin nearly smooth, dark green; salmon flesh; a good cropper.
Ispahan	May 26		Did not do well.
Livingston's Columbus	May 26	September 13, 26	Green flesh; peculiar in shape, color and markings; buff skin with thick whitish netting; nearly free from ribs; flesh thick and solid; small seed cavity; good quality and a good keeper; a good cropper.
Long Island Beauty	May 26	September 13, 26	One of the best tested here this season; red flesh; skin buff, netted, ribbed, beautiful; fine quality.

Muskmelons — (*Concluded*).

NAME.	When sown.	When shipped.	Remarks.
New Early Hackensack	May 26	September 13, 26	Large, round, netted, good quality; a good cropper.
Netted Gem	May 26	September 13, 26	Beautiful, green skin, netted, ribbed, globular; light green flesh; medium size, uniform.
Orange Christina	May 26	September 13, 26	A well known sort; round, very sweet orange flesh; one of the best of its class.
Tip Top	May 26	September 13, 26	Round or oblong; ribs quite deep; rind pale green, somewhat netted; large size, small seed cavity, firm, pale salmon flesh, excellent flavor; an excellent cropper of uniform sized fruit.
Westley Hall	May 26	September 13, 26	Netted green skin; thick scarlet flesh; round, medium size; not a good cropper here.

Watermelons.

NAME.	When sown.	When shipped.	Remarks.
Fordhook Early	May 20	....	Early; good quality; good cropper.

Okra.

The soil for okra was prepared in the manner described for bush beans on p. 547. The seed was sown in drills and the young plants were thinned to six inches apart for the dwarf kind, and eight inches apart for the tall kind. The drills were two feet apart for the dwarf okra and four feet apart for the tall okra. Five or six applications of a mixture of wood ashes and bone meal were made at different times during the season. The total amount applied for the season being about three hundred pounds per acre. It was sown near the drills and lightly cultivated in. The okra was packed in the manner described for beans on p. 548. The following is a list of the varieties shipped:

Okra.

NAME.	When planted.	When shipped.	Remarks.
Dwarf Density	May 12	August 7, 12, 18, 21, 28, 30, September 5, 13, 26.	
White Velvet......	May 12	August 12, 18, 21, 28, 30, September 5, 13, 26.	Better in appearance and keeps tender longer than Dwarf Density.

Onions.

The soil for onions was made very rich with stable manure which was plowed under. After thoroughly pulverizing the soil the seed was sown in drills eighteen inches apart. When two inches high the small varieties were thinned to six inches apart in the row and the large varieties to eight inches apart. Several applications of a mixture of wood ashes and bone meal were made during the season, the total amount applied being about three hundred pounds per acre for the season. When ready for shipment they were tied in bunches of six each, the tops and roots were trimmed off and the bunches were packed firmly in open crates. The following is a list of the varieties shipped:

Lfst of Varieties Shipped.

NAME.	When planted.	When shipped.
El Paso	April 28	July 27, August 2. 8, 15, 28.
Extra Early Red	April 28	July 27, August 2, 8, 15, 28.
Giant Rocca	April 28	August 2, 8, 15, 28, September 13.
Giant White Italian	April 28	July 27, August 2, 15.
Giant Yellow Rocca	April 28	July 27, August 2, 8, 15, September 13.
Mammoth Pompeii	April 28	July 27, August 2, 8, 15, 28.
Mammoth Red Tripoli	April 28	
Michigan Yellow Globe	April 28	July 27, August 2, 8, 15, 28.
Market Favorite	April 28	July 27, August 2, 8, 15, 28.
New Adriatic Extra Early Barletta	April 28	
New Giant Red Rocca	April 28	July 27, August 2, 8.
New Mammoth Silver King	April 28	July 27, August 2, 8, 28.
New Silver Ball	April 28	July 27, August 2, 8, 15, 28.
Neapolitan Maggiajola	April 28	
New Queen	April 28	July 27.
Prizetaker	April 28	July 27, August 2, 8, 15, 28, September 13
Red Globe	April 28	July 27, August 2, 8, 15, September 13.
Red Victoria	April 28	July 27, August 2, 8, 15, 28, September 13.
Round Yellow Danvers	April 28	July 27, August 2, 8, 15, 28, September 13.
Silver White Etna	April 28	July 27, August 2, 15.
Southport Large Yellow Globe	April 28	August 2, September 13.
White Silver Skin	April 28	July 27, August 2, 8, 15, 28, September 13.
White Victoria	April 28	July 27, August 2.
White Globe	April 28	August 2, 8, 15.
Wethersfield	April 28	July 27, August 2, 8, 15, 28, September 13
Yellow Globe Danvers	April 28	July 27, August 2, 8, 15.
Yellow Dutch	April 28	July 27, August 2, 8, 15.

Parsnips.

The parsnips grown for exhibition were very large, long and smooth. They were grown in the following manner: The soil was given a light dressing of manure which was plowed under. The ground was then harrowed till it was finely pulverized and the rows were then marked eighteen inches apart. At distances of nine inches apart in the row holes two feet deep were made with an iron bar and filled with a mixture of fine soil, sand and

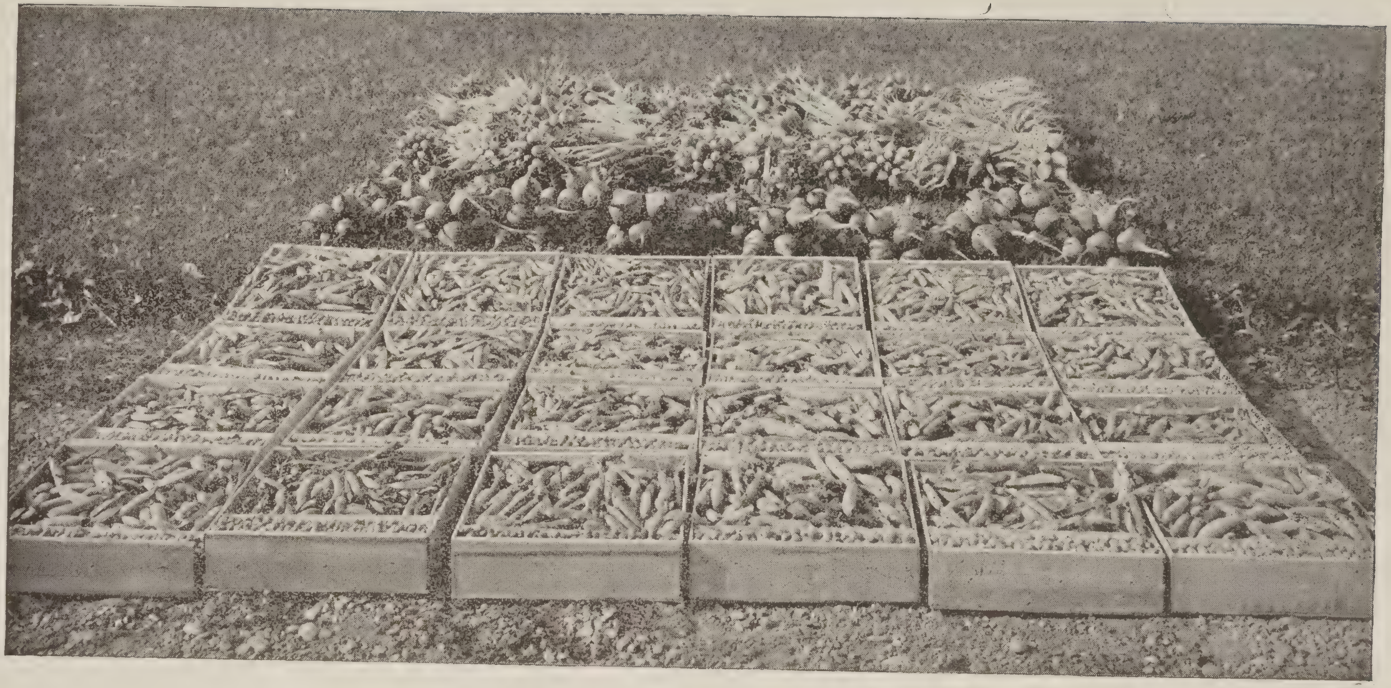

PLATE II.— A shipment of peas, beets and radishes

leaf mold. In each place thus prepared four seeds were sown April twentieth. After the plants came up they were thinned to one plant every nine inches. They were fertilized during the season in the manner described for onions on p. 573, and the ground was kept mellow by frequent shallow cultivation. When ready for shipment they were tied in bunches of six each and packed firmly in open crates. The variety grown was Thorburn's Hollow Crown, which did very well on this soil, even when grown without the special preparation above described.

Peas.

The soil was given a light dressing of stable manure which was plowed under and the ground was then harrowed till it was mellow. The seed was sown in drills four feet apart for the dwarfs and six feet apart for the tall kinds. Those varieties which needed it were bushed when about three inches high. A little soil was thrown against the vines each time they were cultivated till a ridge was formed about three inches high. As soon as they came into blossom they were given an application of liquid manure diluted with an equal quantity of water. This application was repeated at least once a week till the crop was gathered.

The peas were shipped in boxes a foot square and three inches deep made in the manner described on p. 559. A narrow trough at one end was filled with shelled peas as shown in plate II, which is reproduced from a photograph of some boxes filled for shipment. The following varieties were shipped:

Peas.

NAME.	When planted.	When shipped.	Remarks.
Alaska	May 8	June 27, July 5	Good growth; first early; even cropper. Daniel O'Rourke class.
American Wonder	May 8	July 1	Pods good size; not a good cropper; too dwarf; not so good as other dwarfs tested here this season.
"Burpee's Best" Extra Early	May 8	June 27, July 5	First early; no better than other first earlies grown here this season; Daniel O'Rourke class.
Burpee's Extra Early	May 8	June 27, July 5	First early; Daniel O'Rourke class.
Burpee's Profusion	May 8	July 11, 17, 22	Good for general crop; very productive; a vigorous dwarf.
Burpee's Quality	May 8	July 11, 17	More of a dwarf variety than preceding and with shorter pods; very productive.
Burpee's Quantity	May 8	July 11, 17, 22	This has good quality. Somewhat more productive than Burpee's Quality and a stronger grower; a vigorous dwarf.
Bliss Abundance	May 8	July 11, 17, 22	Growth similar to Burpee's Profusion, but peas are of better quality and very productive.
Bliss Everbearing	May 8	July 11, 17, 22	Stronger grower than the four preceding kinds, but not superior in quality; half dwarf.
Blackeyed Marrowfat	May 8	July 11, 17, 22	An old and good variety of tall peas; good quality and a good cropper.
Champion of England	May 8	July 11, 17, 22	A good cropper; tall; excellent quality. An old variety.
Carter's First Crop	May 8	June 27, July 5, 11	First early; somewhat better cropper than the other first early varieties grown here this season, but no better in quality than some others of its class. Vines somewhat below medium height. Daniel O'Rourke class.
Carter's Premium Gem	May 8	July 1	Dwarf; good quality and fair cropper for its class.
Carter's Telephone, Vick	May 8	July 7, 17, 22	First class in quality, vigor and productiveness; very large pea and pod; long season; one of the best of its class; vines below medium height.

Culverwell's Telegraph	May 8	July 7, 17, 22	Vines below medium size; pods large but pea not so large as Carter's Telephone; long season; good cropper.
Daniels	May 9	July 7, 17	Tall; compact; narrow; large pea and pod; good quality; good cropper.
Duke of Albany	May 8	July 7, 17, 22	Very large pod and pea; excellent quality; productive; vines below medium size.
Dwarf Blue Imperial	May 8	July 17, 22	Not of the best quality, but vigorous and a good cropper; vines below medium size. Differs from ordinary garden peas in that the thin pod fits closely to the inclosed peas, thus showing the outline of the peas.
Dwarf Sugar	May 8	July 11	A novelty; not very sweet; blossoms are handsome, having deep purple wings and lavender standards.
Dwarf Gray Sugar	May 8	July 11	Seems to be identical with the Dwarf Sugar.
Early Kent	May 8	June 27, July 11	First early; good cropper; good quality. Among the most productive of the first early varieties grown here this season. Vines below medium size; Daniel O'Rourke class.
Extra Early Premium Gem	May 8	July 1, 11	A vigorous dwarf; very productive; good quality. Equal to any of the second early dwarfs grown here this season.
First and Best Burpee	May 8	June 27, July 1, 11	First early; among the most productive of the preceding first early sorts; slightly more vigorous. Vines below medium size; Daniel O'Rourke class.
Gem of the Season	May 8	June 27, July 11	Vines below medium size; good cropper; not quite so vigorous, but about as productive as preceding. First early; Daniel O'Rourke class.
Horsford's Market	May 8	July 17, 22	Vigorous; good size; good cropper; vines below medium size.
Heroine	May 8	July 1, 11	Dwarf; good for its class.
Improved Dan O'Rourke	May 8	June 27, July 11	One of the best of the old varieties. It is first early, productive and of good quality. Vines below medium size.
Juno	May 8	July 17, 22	A good general cropper; not first in quality, otherwise equal to any of its class grown here this season. Vines below medium size.
Laxton's Earliest of All	May 8	June 27, July 11	A good first early; vines below medium size; Daniel O'Rourke class.
Laxton's Evolution	May 8	July 22	A tall marrow; good quality; vigorous; productive; medium to large in pod and pea.
Laxton's Alpha	May 9	July 1, 22	Compares favorably with any of its class grown here this season. Vines below medium size.

Peas — (*Concluded*).

NAME.	When planted.	When shipped.	Remarks.
Lye's Favorite	May 9	July 7	Tall; good quality; good cropper.
McLean's Little Gem	May 9	July 1	Dwarf; productive; good flavor and quality.
McLean's Blue Peter	May 9	July 5	Dwarf; good cropper; good quality. One of the best of its class grown here this season.
McLean's Advancer	May 9	July 5, 22	Dwarf. The most vigorous and productive of its class grown here this season. A good, old variety.
Matchless Marrow, Daniels	May 9	July 17, 22	Tall; remarkable for the large size of pea and pod; excellent quality and a good cropper. One of the finest in the whole collection grown here this season.
Ne Plus Ultra	May 9	July 22	Vigorous; tall; good quality.
Philadelphia Extra Early	May 9	June 27	First early; good quality; productive; Dan'l O'Rourke class.
Pride of the Market	May 9	July 17, 22	Vigorous; remarkably large pea and pod for its class, but not best in flavor; a good cropper. Vines below medium size.
Prince of Wales	May 9	July 7, 17	Large pea; excellent quality; good cropper; vines below medium size.
Royal Dwarf White Marrowfat	May 9	July 17, 22	First quality; vigorous; tall; good cropper.
Stratagem	May 9	July 17, 22	First quality; fine flavor; vigorous; good cropper; tall compact vines.
Shropshire Hero	May 9	July 17, 22	First quality; fine flavor; vigorous; good cropper; large pod and good sized pea. Vigorous half dwarf.
Tall Sugar	May 9	July 17	Tall; vigorous; good cropper; poor quality; no flavor; turns black when cooked; blossoms like those of the Dwarf Sugar.
Tom Thumb	May 9	July 1	An old variety; too dwarf to be of much value.
Vick's Charmer	May 9	July 7	Tall; good quality; fine cropper; medium pod and pea.
Vick's Extra Early	May 9	July 1	Good of its class; first early; Dan'l O'Rourke class.

Vick's King of the Dwarfs	May 9	July 1	Good of its class.
White Marrowfat	May 9	July 22	Tall; good quality.
Yorkshire Hero	May 9	July 17, 22	A very vigorous half dwarf; medium pod; large pea; good flavor and quality; very productive. One of the best of its class.

Peppers.

The peppers were grown in the manner described for egg plant. See page 566. They were set in rows four feet apart and the plants were three feet apart in the row They were packed in boxes similar to those used for snap beans. See page 548.

The following varieties were grown:

Peppers — (*Continued*).

NAME.	When planted.	When shipped.	Remarks.
Bird's Eye	June 5		Low, spreading, dwarf habit; vigorous foliage; set very little fruit early; was too tender to ship. Late in the season it began to set plenty of fruit.
Black Nubian	June 5	August 7, September 26	Long, black purple pods; vigorous; very productive; first early.
Cranberry	June 5	September 12, 26	Very productive; vigorous, upright habit; fruit somewhat larger than cranberries, of a brilliant red color.
Cherry Formed	June 5	September 12	Quite similar to Cranberry, except that the fruit is a little larger. being nearly an inch in diameter.
Coral Gem Bouquet	June 5	September 12, 16	Dwarf spreading habit; narrow pods, about an inch and a half long, bright coral red; handsome and very productive.
Golden Dawn	June 5	September 12, 16	Large, inverted bell shape, handsome yellow; about three inches long; fairly productive.
Golden King	June 5	September 12	Vigorous grower.
Golden Upright	June 5		Upright habit; very large leaves; fruit larger, more flattened at the apex, more irregular in shape than Golden Dawn; not so productive as Golden Dawn.
Kaleidoscope	June 5	September 12, 16	Quite similar to Red Cluster, but a stronger grower and the fruits are more irregular; no purplish fruits were seen as in Red Cluster; very vigorous and productive.
Large Bell	June 5	September 12	Similar to Golden Dawn, except the fruit is red instead of yellow.
Long Red Cayenne	June 5	September 12, 26	Fairly productive, narrow red pods, four or five inches long.
Long Red	June 5		Up to October tenth no fruit had been shipped.
Long Yellow	June 5	September 12, 26	Somewhat similar to Long Red Cayenne, except that the pods are thicker and of a deep yellow color; a shy bearer here this season.
New Celestial	June 5	September 12, 26	Round, brilliant, pale, yellow, varying to purple or red; about two inches long; exceedingly productive and very handsome.
New Spanish Monstrous	June 5		Up to October tenth no fruit had been shipped; fruit large and long.

Peppers — (*Concluded*).

NAME.	When planted.	When shipped.	Remarks.
New Dwarf Early Red Squash	June 5	August 3, September 12, 26	Large leaves, dwarf habit; fruit similar in shape and color to a flat, red tomato.
New Cardinal	June 5		No fruit had been shipped up to October tenth. Large, long, brilliant red pod; not very productive.
New County Fair	June 5	August 30, September 12, 26	Fairly productive but slow in ripening; brilliant red, with mild red flesh; oblong, pointed; four or five inches long by two in diameter.
Procopp's Giant	June 5		Up to October tenth none had been shipped.
Red Chili, Vick	June 5	September 12, 26	Long, narrow, red pods, not so large as Black Nubian; upright, vigorous grower; very productive.
Red Cluster, Burpee's	June 5	September 12, 26	Productive; vigorous; rather large foliage for a dwarf; compact habit; peppers narrow, two or three inches long, pointed, bright red and borne in clusters pointing upwards.
Red Etna	June 5		Fairly productive, vigorous, bright red, large, oblong, nearly cylindrical, about three inches long.
Red Chili, Burpee	June 5	September 12, 26	Fruit about the size and color of Red Cluster, but more blunt at the apex; bush not as compact in habit; a fine cropper.
Red Cluster, Vick's	June 5	September 12, 26	Quite similar to Burpee's, but a stronger grower, and the fruits are more irregular.
Ruby King	June 5		None shipped up to October tenth.
Sweet Mountain	June 5	September 12, 26	Vigorous; large bell shape; red; very mild; fairly productive.
Wrinkled Mixed	June 5	September 12, 26	Spreading habit; very productive but ripens slowly; brilliant red fruit, about an inch and a half long; irregular ovate.

Radishes.

The soil for radishes was prepared in the manner described for bush beans on p. 547, and the seed sown in drills eighteen inches apart was covered about half an inch deep. When the plants were still quite small they were thinned to two or three inches apart in the row and once a week they were given a light application of a mixture of wood ashes and bone meal which was worked into the soil with shallow cultivation. When ready for market they were tied in bunches of twelve each and about half the tops were cut away. The bunches were then firmly packed in open crates. The following varieties were shipped :

Radishes.

NAME.	When sown.	When shipped.	Remarks.
Burpee's Earliest	April 27 June 15 Aug. 3	June 13 July 13, 17 September 1, 8, 13	Good quality; scarlet turnip.
Burpee's Surprise	April 27 June 15 Aug. 3	June 13 July 13, 17 September 1, 8, 13, 26, October 3	Turnip; not a clear yellow; long season; good quality.
Bartelde's Glass	June 15	July 17	Beautiful pale rose with white tip; long; good quality.
Beckert's Chartier	April 27 June 15 Aug. 3	June 13 July 13, 17 September 1, 8, 13, 26, October 3	Pale rose; almost white tip; long, solid; good quality; late or winter; long season.
Chinese Rose Winter, Burpee's	April 27 June 15 Aug. 3	June 13 July 17 September 8, 13, 26, October 3	A late or winter radish; pale rose, almost white tip; half long.
Chartier	April 28 June 15 Aug. 13	June 13 July 13, 17 September 1, 8, 13, 26, October 3	Beautiful pale rose, white tip.
Dark Red Ball	May 11 June 15 Aug. 3	June 13 July 13, 17 September 1, 8, 13	Well described by its name; handsome in appearance.
Early Long Scarlet Short Top	April 27 June 15 Aug. 3	June 13 July 13, 17 September 1, 8, 13, 26	An old variety and one of the best; mild, solid flesh; fine red color.
Early Yellow Ball	May 11 June 15 Aug. 3	June 13 July 13, 17 September 1, 8, 13, October 3	Rusty yellow color.
Extra Early Scarlet Turnip	May 11 June 15 Aug. 3	June 13, July 1 July 13, 17 September 1, 8, 13	Handsome color; well described by the name; firm; good.
Earliest Carmine Olive Shaped	May 11 June 15 Aug. 3	June 13, July 1 July 13, 17 September 1, 8, 13	No earlier than others of its class grown here this season; handsome carmine olive shaped; good.

Early Round Dark Red	April 27 June 15 Aug. 13	June 13 July 13, 17 September 1, 8, 13	Well named; fine color; turnip shape.
French Breakfast	May 11 June 15 Aug. 3	June 13, July 1 July 13, 17 September 1, 8, 13	Olive shape; scarlet with white tip; one of the best.
Golden Dresden	April 27 June 15 Aug. 3	June 13 July 13, 17 September 1, 8, 13, 26, October 3	A yellow turnip, handsome in appearance.
Golden Yellow Summer Turnip	June 15 Aug. 3	July 13, 17 September 1, 8, 13	Rusty yellow.
Giant White Stuttgart, Vick	April 28 June 15	June 13 July 13, 17	Identical with Burpee's White Giant Stuttgart Summer.
Half Long Deep Scarlet	April 28 June 15 Aug. 3	June 13, July 1 July 13, 17 September 1, 8, 13	Well named; beautiful color.
Long White Vienna, Burpee's	May 11 June 15 Aug. 3	June 13, July 1 July 13, 17 September 1, 8, 13, 26	Large, long, beautiful white color; solid flesh, good shape.
Long White Naples	April 28 June 15	June 13, July 1 July 13	A first-class, long, white variety.
Long White Spanish Winter	June 15 Aug. 3	July 13, 17 September 26, October 3	A fine, long, white variety; good quality
Long Scarlet Short Top, Vick	April 28 June 15 Aug. 3	June 13, July 1 July 13, 17, September 1 September 8, 13, 26	Identical with "Burpee's Early Long Scarlet Short Top."
Long Cardinal	June 15 Aug. 3	July 13, 17 September 1, 8, 13	One of the handsomest grown here this season; color well described by its name; half-long.
Large White Globe	April 28 June 15 Aug. 3	June 13, July 1 July 13, 17, September 1 September 13, 26, October 3	A beautiful, white, solid, turnip-shaped radish.
Philadelphia White Box	May 11 June 15 Aug. 3	June 13 July 13, 17, September 1 September 8, 13, 26	Clear white color; turnip-shaped.
Rose Olive-Shaped	April 28 June 15 Aug. 3	June 13, July 1 July 13, 17 September 1, 8, 13	Half-long; rose; good color; fine exhibition variety.

Radishes — (*Concluded*).

NAME.	When sown.	When shipped.	Remarks.
Scarlet Turnip White Tip	April 28 June 15	June 13, July 1 July 13, 17, September 1 September 8, 13	A beauty; well described by its name.
Scarlet Olive Shaped	April 28 June 15	June 13, July 1 July 13, 17	Beautiful in appearance; well described by its name.
Scarlet Turnip	April 28 June 15 Aug. 5	June 13, July 1 July 13, 17, September 1 September 8, 13	Well described by its name; beautiful in appearance.
Vick's Early Scarlet Globe	April 28 June 15 Aug. 5	June 13, July 1 July 13, 17, September 1 September 8, 13	A good scarlet turnip radish.
Violet Olive-Shaped White Tip	April 28 June 15 Aug. 5	June 13, July 1 July 13, 17 September 8, 13, 26	One of the handsomest grown here this season; color well described by its name.
Violet Turnip, White Tip	June 15 Aug. 5	July 13, 17, September 1 September 8, 13, 26, October 3	Well named; handsome in appearance.
Wood's Early Frame	April 28 June 15 Aug. 5	June 13, July 1 July 13, 17, September 1 September 8, 13, 26	Long scarlet; white tip; a fine old sort.
White Turnip	April 28 June 15 Aug. 5	June 13, July 1 July 13, 17, September 1 September 8, 13, 26	Well named; a good sort.
White Summer Turnip	April 27 June 15 Aug. 3	June 13 July 13, 17, September 1 September 8, 13, October 3	Described by its name.
Yellow Turnip	April 27 June 15	June 13, July 1 July 13, 17, September 1	Similar to Golden Dresden, but lighter color.
White Olive Shaped	April 28 June 15 Aug. 5	June 13 July 13, 17, September 1 September 13	Well described by its name; handsome white color; fine for exhibition.

White Strasburg	April 28 June 15 Aug. 5	June 13 July 13, 17, September 1 September 8, 13, 26, October 3	Beautiful white; half long.
White Tipped Scarlet Ball	May 11 June 15 Aug. 5	June 13 July 13, 17, September 1 September 8, 13	Well described by its name; a beautiful radish.
White Giant Stuttgart Summer, Burpee's	June 15 Aug. 5	July 13, 17 September 13, 26, October 3	Long white; a good sort.

Salsify.

For salsify a liberal dressing of well rotted stable manure was plowed under and the ground was harrowed till it was mellow. The seed was sown April 28, in drills eighteen inches apart and the young plants were thinned to eight inches apart in the row. The crop was cultivated, fertilized and shipped in the manner described for parsnips on p. 574. The only kind grown was Mammoth Sandwich Island which on this soil produced clean, straight roots above medium size. It was shipped July 27, August 15 and September 13.

Squash.

The squash was started in frames in the manner described for cucumbers on p. 562, and was afterwards given the same kind of treatment as is there set forth. When ready to ship they were packed firmly in excelsior in open crates. The following is the list of varieties shipped :

Squash.

NAME.	When sown.	When shipped.	Remarks.
Boston Marrow	May 20	August 2, 8, 12, 25, September 1, 13, 26	Large; deep orange color; ovate or round ovate; good cropper.
Brazil Sugar	May 20	August 25	Small; oblong; smooth; yellow; good cropper.
Butman	May 20	August 25	Ovate; large; nearly white, mottled with dark green; good cropper.
Der Wing	May 20	August 12, 16, 25, September 1, 13, 26	Round, ovate, pointed, warty; pale green color in rind and flesh; good crooper.
Early White Scallop Bush	May 20	July 28, August 1, 8, 12, 16 25, September 13, 26	An excellent cropper of fine appearance; delicate color; nearly white.
Early Yellow Bush Scalloped	May 20	August 8, 12, 25, September 1, 13, 26	Fine yellow color; excellent cropper.
Essex Hybrid	May 20	August 8, 16, 25, September 1	Round ovate; pointed at either end; pale reddish yellow; not very productive here.
Fordhook	May 20	August 12, 16, 25, September 1, 13, 26	A very pretty squash; oblong; delicate pale yellow flesh with darker rind; good cropper.
Golden Summer Crookneck	May 20	July 28, August 2, 8, 16, 25, September 1, 13, 26	Well described by its name; an excellent cropper; an old sort.
Henderson's Delicata	May 20	August 12, 16, 25, September 1, 13, 26	Long oblong, pointed, ribbed; yellow mottled with dark green delicate orange-colored flesh; an excellent cropper.
Hubbard	May 20	August 16, September 1, 13, 26	An old variety; needs no description; by many considered the best in quality for winter use.
Improved Cocozelle Bush	May 20	July 28, August 2, 8, 12, 16, 25, September 1, 13, 26	Dark green, long, slender, smooth; excellent cropper.
Mammoth Chili	May 20	August 12, 16, September 13, 26	Large pumpkin shape; pale yellow slightly striped with dark green; fair cropper.
Mammoth Yellow Bush	May 20	July 28, August 1, 7, 8, 12, 16, 25, September 1, 13, 26	Scalloped; excellent cropper; larger than the common Yellow Bush.
New Mammoth White Scallop Bush	May 20	July 28, August 1, 8, 12, 16, September 1, 13, 26	Larger than the common White Scalloped in size; a good cropper.

Squash — (*Concluded*).

NAME.	When sown.	When shipped.	Remarks.
New Eureka	May 20	August 8, 12, 25, September 1, 13, 26	Pale reddish yellow striped with green, large, pointed, ovate; fair cropper.
Perfect Gem Winter Crookneck	May 20	August 12, 16, 25, September 1, 13, 26	Dark green, mottled with pale green; smooth, large; cream-colored flesh; fair cropper.
Pike's Peak	May 20	September 1, 13, 26	Pale green rind, smooth, large as Hubbard; round ovate; yellow flesh; excellent cropper.
Strickler's Summer Squash	May 20	July 28, August 1, 8, 12, 16, 25, September 1, 13, 26	Beautiful yellow; larger than the common Crookneck; a better keeper and a better cropper as grown here.
Small Cocoanut Squash	May 20	August 16, 25, September 1, 13, 26	Small, round; creamy yellow, with a nearly square patch of green over the apex; yellow flesh; excellent cropper.
Warren	May 0	August 16, 25, September 1, 26	Pale yellow; globular, flattened at either end and the rind folded in near the apex somewhat after style of the Turk's Cap gourd; yellow flesh; fairly good cropper.

Tomatoes.

The tomatoes were started in the hot bed, transplanted to three-inch pots and transferred to frames in the manner described for egg plant on p. 566. They were trained on frames which were made of strips two inches wide and one inch thick nailed to supports four feet long, four inches wide and two inches thick, as illustrated in figure 1. The supports were fastened together at the top like rafters of a roof; the lower end, set four feet apart, were held together by a cross strip two inches wide by one inch thick. The supports were therefore triangular in form, each side measuring four feet. They were set ten feet apart in the row. The strips, four in number for each side, were placed a foot apart and fastened to the support by a single nail, so that at the end of the season the frames might be readily taken apart and stored compactly. The lower strip was set a foot from the bottom and the upper strip at the very top. The distance between the frames was three feet, so that each row was separated from the adjacent row on one side by a distance of three feet, and from the row on the other side by the width of the frame, a distance of four feet. The plants were set close to the frames two feet apart in the row. The ground was not manured before being plowed, but holes were dug for each plant, and a shovelful of well-rotted stable manure was put in each hole and covered with dirt taken from the hole. The ball of earth around the roots of the plant was crushed and the transplanting performed in the manner described for egg plant on p. 566. The plants were trained by permitting but one branch to grow on each side of the main stem thus giving three fruiting stems to each plant. All other laterals were taken off as fast as they appeared and about one-third of the

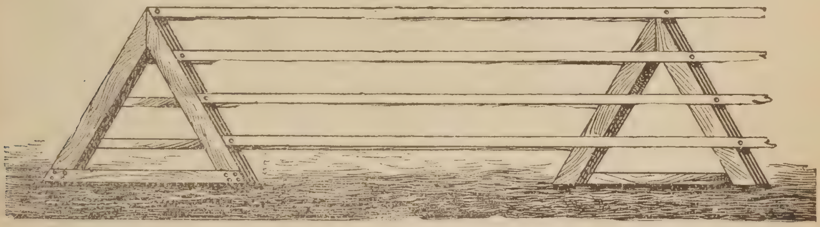

FIG. 1.—*Tomato frame.*

leaves were also trimmed off. Handled in this manner the fruit ripened well and very little rot was seen. The vines were tied to the frames as often as was necessary to keep them in position. The ground was kept free from weeds and twice a week through the season the plants were given liquid manure diluted with an equal quantity of water. The following table shows the average yield per plant of a few varieties grown in this way. The table is based on the yield of five plants of each variety. October twelfth, the fruit remaining on the vines was picked and the amount of green fruit recorded as shown in the second column of the following table:

Tomatoes.

AVERAGE YIELD PER PLANT OF RIPE AND GREEN FRUIT, 1893.

NAME.	Pounds of ripe fruit.	Pounds of green fruit.
Buckeye State	9.3	4.3
Conqueror	16.2	5.3
Earliest of All	15.4	4.5
Early Michigan	6.6	5.7
Golden Ball	4.	5.5
Lemon Blush	6.9	4.8
Long Keeper	7.6	5.5
Rose Peach	6.6	3.5
Terra Cotta	13.1	4.8

The following varieties were sent to the World's Fair:

NAME.	When planted.	When shipped.	Remarks.
Acme	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Smooth; prolific; medium; a dull purplish color.
Aristocrat Dwarf	May 31	August 9, 18, 23, 30, September 6, 13, 26,	Dwarf, resembling Dwarf Champion in fruit and plant but somewhat larger; orange red; medium; smooth; very prolific.
Atlantic Prize	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13	Smooth, or somewhat ribbed; medium size; rather flat; moderate cropper; fine scarlet color.
Burpee's Climax	May 31	August 9, 12, 18, 23, 30, September 6, 13, 26	Medium; smooth; fair cropper; handsome purplish red.
Bond's Early Minnesota	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13	Purplish red; small; round; smooth; good cropper; a handsome small tomato.
Chemin	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Liable to crack as grown on this soil; good cropper; inclined to oblong shape; smooth; fine red color.
Conqueror	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Somewhat wrinkled and irregular; medium; good, bright, scarlet color; good cropper; not remarkably vigorous on our soil.
Dwarf Champion	May 31	August 9, 12, 18, 23, 30, September 6, 13, 26	A well-known variety, vigorous, productive.
Extra Early Advance	May 31	August 1, 9, 12, 18, 23, 30, Sept. 6, 13, 26.	Smooth; fine shape; good scarlet color; vigorous; fairly productive,
Early Optimus	May 31	August 9, 12, 18, 23, 30, Sept. 6, 13, 26	Above medium; good cropper; fine shape; smooth; bright scarlet; very vigorous.
Essex Early Hybrid	May 31	August 9, 12, 18, 23, 30, Sept. 6, 13, 26	Medium; round; smooth; one of the best in color; bright scarlet; fairly productive.
Early Michigan	May 31	August 1, 9, 12, 18, 23, 30, Sept 6, 13, 26.	Above medium; one of the best in color; bright scarlet; vigorous.
Early Mayflower	May 31	August 1, 9, 12, 18, 23, 30, Sept. 6, 13, 26.	Nearly round; above medium; bright scarlet; good form; very productive.
Golden Trophy	May 31	August 1, 9, 12, 18, 23, 30, Sept. 6, 13, 26.	Medium or above; clear yellow; smooth; good form; fine cropper; one of the best of its color; very vigorous.

Tomatoes — (*Continued*).

NAME.	When planted.	When shipped.	Remarks.
Golden Queen	May 31	August 1, 9, 12, 18, 23, 30, Sept. 6, 13, 26.	More nearly round than Golden Trophy; not so good in color; smooth; fine form; very productive; vigorous.
Hathaway's Excelsior	May 31	August 1, 9, 12, 18, 23, 30, Sept. 6, 13, 26.	Good red color; medium or below; round; smooth; good cropper; shows a slight tendency to crack as grown on this soil.
Horsford's Prelude	May 31	August 1, 9, 12, 18, 23, 30, Sept. 6, 13	Small; very productive; fine, bright scarlet; smooth; vigorous.
Ignotum, Burpee's	May 31	August 1, 9, 12, 18, 23, 30, Sept. 6, 13, 26.	Large; smooth; fine bright red color; very productive; vigorous.
Ignotum, Hall	May 31	August 9, 12, 18, 23, 30, Sept. 6, 13, 26	Identical with the preceding in every respect except that it was somewhat later.
Livingston's Beauty	May 31	August 1, 9, 12, 18, 23, 30, Sept. 6, 13, 26.	Purplish red; fine form; medium; smooth; fine cropper.
Livingston's Golden Ball	May 31	August 1, 9, 18, 23, 30, Sept. 6, 13, 26	Somewhat oblong; smooth; canary yellow; small; very productive; vigorous.
Livingston's Perfection	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Small to medium; fine bright red color; smooth; moderately productive.
Livingston's New Favorite	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Large; smooth; moderately productive; bright red.
Livingston's Large Rose Peach	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Its name describes its color; medium; good cropper; slightly oblong; skin covered with a delicate pubescence giving a marked contrast to the shining, smooth skin of common sorts.
Livingston's Buckeye State	May 31	August 12, 18, 23, 30, September 6, 13, 26.	Fruit very large, smooth; a fine variety but of a dull, purplish red color.
Long Keeper, Burpee's	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Smooth; nearly round; handsome purplish red; medium size.
Long Keeper, Thorburn's	May 31	August 9, 12, 18, 23, 30, September 6, 26.	Identical with the preceding, except possibly more productive and second early.
Lemon Blush	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Handsome lemon yellow; nearly round and smooth; vigorous; medium or above.
Lorillard	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Smooth; medium; first-class color, bright scarlet; an old forcing variety; vigorous; good cropper.

Large Yellow	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Large; yellow; handsome; smooth; good cropper; very vigorous.
McCullum's Hybrid	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Above medium; bright scarlet; smooth; fine form; good cropper; very productive.
Matchless	May 31	August 9, 18, 23, 30, September 6, 13, 26.	Medium; smooth; somewhat flattened; good red color; fair cropper.
New Currant	May 31	August 18, 30, September 6, 13	Size of small cherries; handsome deep scarlet color; borne in racemes; longer clusters and with more fruit in a cluster than "Red Cherry;" very productive.
New White Apple	May 31	August 9, 18, 23, 30, September 6, 13, 26.	Clustered somewhat like the Currant tomato, but not so many fruits in the cluster. Color white, shaded with yellow towards the stem; oblong, nearly round.
Nichols' No. 5	May 31	August 18, 23, 30, September 6, 13, 26	Round; medium or above; smooth; bright purplish red; late but a good cropper; potato leaf; cannot ripen so much fruit here as the earlier varieties; a handsome tomato.
Ponderosa	May 31	August 12, 23, 30, September 6, 13. 26	Very large; uniform in size; nearly smooth.
Paragon	May 31	August 9, 12, 18, 23, 30, September 6, 13	A fine old variety; rich scarlet color; medium; smooth; fairly productive.
Pear Shaped Yellow	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Very productive; below medium; twice as large as Yellow Plum Shaped; well described by its name.
Potato Leaf	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Medium or below; rather flat; smooth; beautiful purplish red; fairly productive.
Peach	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Very vigorous and productive; smaller than Livingston's Large Rose Peach, and has less of a rose color, otherwise quite similar.
Red Cherry	May 31	August 1, 9, 18, 23, 30, September 6, 13, 26	Size of large cherries; golden red color; smooth; borne in racemes of from five or six fruits to three times that number; clusters average about ten to twelve inches long; very productive.
Royal Red	May 31	August 9, 18, 23, 30, September 6, 13, 26.	Medium; good cropper; round; smooth; bright scarlet.
Red Pear Shaped	May 31	August 1, 9, 18, 23, 30, September 6, 13, 26	Very productive and vigorous; not quite as large as "Yellow Pear Shaped," but more nearly pear shaped than that variety.
Stone	May 31	August 9, 12, 18, 23, 30, September 6, 26.	Very fine form, nearly round, perfectly smooth; above medium; bright red; very productive; vigorous.
Scoville's Hybrid	May 31	August 1, 12, 18, 23, 30, September 6, 13, 26	Medium; smooth; nearly round; bright scarlet; fair cropper.

Tomatoes — (*Concluded*).

NAME.	When planted.	When shipped.	Remarks.
Small Round Yellow	May 31	August 1, 9, 18, 23, 30, September 6, 13, 26	Similar to Red Cherry, except in color, which is a golden yellow.
Turner Hybrid	May 31	August 12, 18, 23, September 6, 13, 26	Potato leaf; rather rough in form; good scarlet color; medium size; good cropper.
Trophy	May 31	August 12, 18, 23, September 6, 13, 26	An old variety; fairly smooth; first-class color; above medium; fair cropper.
Trucker's Favorite	May 31	August 1, 9, 12, 18, 30, September 6, 26	Above medium; purplish red; smooth; good cropper; vigorous; nearly round.
Terra Cotta	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13, 26	Fair cropper; irregular, approaching oblong; angular, not wrinkled; skin covered with pubescence like the peach tomato; a dull, yellowish red color; vigorous; very productive; a novelty in color and shape.
The Cardinal	May 31	August 9, 18, 23, 30, September 6, 13, 26	Medium; nearly smooth; good, bright scarlet color; vigorous; good cropper; ripens slowly.
Volunteer	May 31	August 1, 9, 12, 18, 23, September 6, 13, 26	Smooth; flattened; beautiful deep scarlet color; first-class cropper.
Vaughan's Earliest of All	May 31	August 1, 9, 12, 18, 23, September 6, 13, 26	Rough; small to medium; good cropper; handsome, bright red color; moderately vigorous.
Yellow Plum Shaped	May 31	August 1, 9, 12, 18, 23, 30, September 6, 13	Bright canary yellow; small; oblong; handsome; very productive.

Turnips.

The turnips were grown on soil occupied during the early part of the season by radishes. After the radishes were removed a liberal dressing of well rotted stable manure was plowed under. The ground was made mellow and the seed was sown about an inch deep in drills eight inches apart. The young plants were thinned to six inches apart in the row, after which they were given two or three light applications of a mixture of wood ashes and bone meal, the total application for the season being at the rate of about one hundred and fifty pounds per acre. The surface of the ground was kept mellow and free from weeds during the season. The following varieties were grown:

Turnips.

NAME.	When sown.	When shipped.	Remarks.
Early Snowball	Aug. 3		Globular; nearly white; fine grain; good foliage.
Early White Strapleaf	Aug. 3	October 3	Flat; nearly white; very tender and sweet; solid; fine grain; good foliage.
Red Top Strapleaf	Aug. 3	October 3	Flat; nearly white, shaded with dark pink; solid; fine grain; good foliage.
Long White Cow Horn	Aug. 3	October 3	Long, white, resembling long radishes in shape; crisp; tender; foliage rather tender.
White Egg	Aug. 3	October 3	Oval or long; white; tender; solid; sweet flesh; foliage tender.
Yellow Globe	Aug. 3	October 3	Nearly white skin; white flesh; juicy; tender; crisp; sweet; good foliage; rather strong flavor.
Golden Ball	Aug. 3	October 3	Yellow skin and flesh; juicy; tender; crisp; sweet; good foliage; a good winter variety.

Variety Tests of Apples.

The varieties of apples thus far received at this station for testing have, with few exceptions, been top-worked on young bearing trees of Baldwin or Rhode Island Greening. In a few cases they were top-worked on some other variety and in several instances root-grafted or budded trees of the variety to be tested were planted. Many old varieties have been admitted to the orchards for the sake of comparison with the newer sorts.

This top-working of varieties received at the station for testing was begun in 1883, and since then has been continued at intervals till at the present time there are 399 kinds of apples and twenty six kinds of crab apples growing in the station orchards, making a total of 425 varieties.

Many of the kinds first introduced are now bearing from a few fruits to three or four bushels per tree. One hundred and three kinds of apples and thirteen kinds of crab apples were fruited here in 1893, making the total number of varieties fruited 116. Notes on a few of these varieties are given below. It should be remembered that this report does not pretend to make a final statement as to the merits of these varieties, but simply shows their record thus far at this station. Undoubtedly in some localities some of them will do better than they have done here, in other places they may not do so well as they have done here. As the trees become older, it will be possible to make more extended reports and to include new features that may be brought out by the data constantly accumulating in the station's annual records.

Synonyms and temporary names of unnamed seedlings in the following pages are printed in italics.

NOTES ON VARIETIES.

Belborodooskœ.—A Russian variety. Medium to large, green or yellow, sometimes blushed with red, symmetrical, roundish, inclined to conical; calyx closed, set in a shallow wrinkled basin; stem medium length, stout, set in a deep cavity; flesh moderately juicy, not crisp, dull white, coarse, subacid, good quality. Season here is August. A tree was top-worked to this variety nine years ago, and the first few fruits were borne this season. So far as tested it does not appear to have any points of superiority over the standard varieties of its season, at least for the apple-growing sections of this State.

Count Orloff.— A Russian apple. Medium size; conical; sides somewhat flattened; calyx closed; basin wrinkled, medium size, moderately deep; stem short and thick, set in a wide shallow cavity; skin smooth, waxen green, having one side lightly blushed or streaked with pale red; flesh nearly white, dry, poor to fair in flavor and quality; watercores so much as to be worthless. Season August. (See also annual report of this station, 1892, p. 587.)

Cut Wine, *No.* 210.—A Russian apple received from Dr. T. H. Hoskins, Newport, Vt., 1888. Fruit below medium size, nearly symmetrical, covered with delicate bloom. Skin green, lightly shaded with red and with crimson cheek. Basin shallow, wrinkled. Stem medium length, slender, set in a deep cavity. Flesh mild subacid, fair to good in quality. Begins to ripen here about the first of August.

Dickinson.— A seedling of the Yellow Bellflower, which it resembles in shape. It originated with Mr. Dickinson, of Westchester, Pa. Fruit medium to large, oblong, flattened lengthwise. Skin yellow, mottled or nearly covered with a fine dark red color. Stem about an inch long, rather slender, set in a moderately deep, irregular cavity. Calyx with large segments nearly closed, is set in a broad ribbed or corrugated basin. Flesh white, not very juicy, slightly subacid, fair to good in quality. Begins to ripen here in December. Tree top-worked five years ago, gave a fair yield this year.

Grand Sultan.— A Russian apple received from Ellwanger & Barry, Rochester, N. Y. See also annual report of this station 1892, p. 587. Fruit medium to large, roundish oblong, pale yellow splashed on one side with carmine. Stem long, rather slender, set in a medium-sized cavity. Calyx large, set in a smooth, broad, shallow basin. Flesh nearly white, rather coarse, juicy, brisk subacid, fair to good in flavor and quality. It has a tendency to rot at the core and to become watercored. Tree a free grower and productive. Season here, August.

No. 226 Department.— By a typographical error this was called "No. 225 Department" in the report of this station for last year, 1892, p. 587.

Peter.— From Peter M. Gideon, Excelsior, Minn. In form, size and color the fruit resembles Wealthy. Have not yet seen in it the red streaks through the flesh which the Wealthy sometimes shows. Flesh not so white as that of Wealthy, but milder and better in quality. Fruit oblate or roundish oblate, pale yellow, shaded or striped with deep red. Stem moderately long, slender, set in a smooth deep green or slightly russeted cavity; calyx closed; basin abrupt and deep. Begins to ripen in September. Tree top-worked five years ago, bore its first specimens of fruit this year.

Picta Striata, Crab Apple.— Fruit above medium size for a crab apple, yellow striped or nearly covered with crimson. The closed calyx is set in a broad moderately deep basin. The stem, about one and a half inches long is set in a deep cavity. Fruit oblate or roundish oblate. Flesh yellowish, mild subacid with crab flavor. Season, late fall and early winter. Top-worked on a bearing tree five years ago, and bore a fair crop of fruit this season.

Princess Louise.— Received from Smith & Kernan, St. Catharines, Ontario, 1888. Fruit of Fameuse type, medium size, roundish or roundish oblate; skin pale yellow, striped or nearly covered with red; stem rather short, set in a deep cavity; calyx small, closed, set in a narrow basin. Flesh white, very juicy, subacid; inferior to Fameuse in flavor and quality. Ripe here in December. Top-worked on a bearing tree five years ago, and bore a fair crop this season.

This apple originated with L. Woolverton, Secretary of the Ontario Fruit Grower's Association, Grimsby, Ontario, who has furnished the following statement of its origin: "This apple originated on my own fruit farm. It was a chance seedling that sprung up among half a dozen old Fameuse trees. These apples were so scabby that they were seldom picked, and so rotted upon the ground. I think, therefore, that I am justified in saying that the tree is a seedling of the Fameuse. The original tree appears to be about twelve or fifteen years of age, and bears a medium crop of apples with highly colored cheeks on the sunny side They are entirely free from *Fusicladium*, and are much larger than the Snow; the quality is quite as good, and the apple keeps until February, and may, therefore, be classed among winter apples. The tree is somewhat slender in habit of growth, but I think very healthy."

September **Crab Apple.**—A seedling of Cherry Crab from Peter M. Gideon, Excelsior, Minn. Fruit larger and a few days later than Transcendent, not uniform in shape, varying from oblong to oblate; stem about an inch long, slender, set in a deep, smooth cavity; calyx closed, set in a moderately deep basin; skin thin, smooth, with delicate bloom, streaked or nearly covered with dark red; flesh yellowish, subacid, moderately juicy, with an agreeable crabapple flavor, not astringent, very good quality. Top-worked on bearing tree five years ago and produced a few specimens of fruit this season. The true September apple is entirely distinct from this fruit.

Sharp.—Received from Benjamin Buckman, Farmingdale, Ill., 1889. Top-worked in bearing tree then, it bore a few fruits this season, from which the following description was made:

Fruit medium size, oblong conical, handsome yellow, sprinkled with brown dots and usually half its surface marbled and shaded with carmine and crimson. The short stem is set in a wide, deep, russeted cavity; calyx closed, set in a wrinkled, moderately shallow basin; flesh nearly white, fine grained, tender, moderately juicy, nearly sweet, mild and pleasant flavor, very good quality; ripe here in October.

White Pigeon.—This is a Russian apple of United States Department of Agriculture importation. It was received here in 1888 from Dr. T. H. Hoskins, Newport, Vt. Top-worked on a bearing tree five years ago and bore a few fruits this season which ripened in August. The fruit was medium to large, roundish oblate conical; calyx closed, set in a shallow wrinkled basin; stem long, slender, set in a deep cavity; skin pale yellow, splashed over half its surface with bright red; flesh nearly white, rather firm, not very juicy, moderately sweet, good quality and good flavor.

Professor J. L. Budd says that the Striped Anis has also been disseminated by the Department under the name of White Pigeon,* but the fruit produced by the White Pigeon at this station does not agree with his description of the fruit of Striped Anis.

Wine Rubets, *Cut Wine, Vinograd, No.* 210 *Department.*—A Russian apple imported by the United States Department of Agriculture. It was received here in 1888 from Dr. T. H. Hoskins, Newport, Vt., under the name Cut Wine. Fruit below medium size, nearly symmetrical, covered with a delicate bloom; skin green, lightly shaded with red and with crimson cheek; basin shallow, wrinkled; stem medium length, slender, set in a deep cavity; flesh mild subacid, fair to good in quality; begins to ripen here about the first of August. See also bulletin of Prof. J. L. Budd, Ames, Iowa, 1885, on "North East Europe Fruits," page 7.

YIELD OF APPLES IN 1893.

The following table compares the yield of the different varieties of apples in Station Orchard No. 2 that fruited at the station in 1893, shows the orchard age of the trees and at the same time indicates which of the trees were planted and which were top-worked on bearing stock. Since the trees are not all of the same orchard age, and since many varieties are just beginning to bear, the orchard age of each variety is given in the following table for the sake of comparison:

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*See bulletins of the Iowa Agricultural College, Ames, Iowa, by Prof. J. L. Budd, 1885, p. 12 and 1890, p. 20.

Table Showing (1) Yield of Apples in 1893; (2) Number of Years Since Each Variety was Top worked on a Young Bearing Tree, or Since it was Planted, and (3) Season of Ripening at Geneva.

NOTE.—The following abbreviations are used to denote the season of ripening: E. S., for early summer; S., for summer; E. F., for early fall; F., for fall; E. W., for early winter; W., for winter; L. W., for late winter. Synonyms are printed in italics.

NAME.	Yield in 1893.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Acuba-leaf Reinette	Good	10		E. W.
Alexander	Fair	10		F.
American Newtown Pippin, see Green Newtown Pippin				
Aporta, see Alexander				
Aunt Ginnie	Few	10		E. F.
Aurora, see Twenty Ounce				
Autumn Streaked	Few	5		F.
Baldwin	Few	10		W.
Baltimore Pippin, see Ben Davis				
Baltimore Red, see Ben Davis				
Baltimore Red Streak, see Ben Davis				
Belborodooskœ	Few		9	S.
Belle Fleur, see Yellow Bellflower				
Bell's Early, see Sops of Wine				
Ben Davis	Very large	10		L. W.
Bennington, see Sops of Wine				
Birth	Few	10		
Boston Russet, see Roxbury Russet				
Brooke's Pippin, see Green Newtown Pippin				
Buckingham	Fair	5		W.
Buckley, see Chenango Strawberry				
Byer's Best, see Buckingham				
Carolina Red Streak, see Ben Davis				
Cayuga Red Streak, see Twenty Ounce				

TABLE SHOWING THE YIELD OF APPLES, ETC., IN 1893 — (*Continued*).

NAME.	Yield in 1893.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Chenango Strawberry	Good	10	....	S.
Coleman, see Twenty Ounce	....	....	....	......
Cooper's Redling, see Cooper's Market	....	....	...	......
Cooper's Market	Fair	10	....	W.
Count Orloff	Fair	....	9	E. S.
Cox's Pomona	Few	10	....	E. F.
Czar's Thorn	Few	....	9	E. F.
Dickinson	Fair	5	....	W.
Dodge's Early Red, see Sops of Wine	....	....	....	......
Duchess of Oldenburg	Fair	10	....	S.
Early French Reinette, see Early Harvest	....	....	....	......
Early Harvest	Few	10	....	E. S.
Early Ripe	Few	5	...	E. S.
Emperor Alexander, see Alexander	....	....	....	......
English Golden, see Golden Russet	....	....	....	......
English Golden Russet, see Golden Russet	....	....	....	......
English Pippin, see Longfield	....	....	....	......
Ernst's Pippin, see Ohio Pippin	....	....	...	......
Esopus Spitzenburg	Few	10	....	W.
Everbearing	Few	4	....	F.
Fallawater	Good	10	....	E. W.
Fall Pippin	Large	10	....	F.
Fall Queen, see Haas	....	....	....	......
Fall Queen, see Buckingham	....	...	....	......
Fall Wine	Few	10	....	F.
Fameuse	Good	10	....	F.
Flory	Few	5	....	......
Frank, see Chenango Strawberry	....	....	. ..	......
Gardener's Apple, see Mother	....	....	....	......
Gideon	Few	5	....	F.
Gideon No. 7	Few	5	....	S.
Gillett's Seedling, see Rome Beauty	....	....	....	......
Golden Russet	Fair	10	....	L. W.
Golden Sweet	Good	10	....	E. F.
Grand Sultan	Good	....	9	E. S.
Gravenstein	Large	10	....	F.
Gray Apple, see Pomme Grise	....	....	....	......

TABLE SHOWING THE YIELD OF APPLES, ETC., IN 1893 —(*Continued*).

NAME.	Yield in 1893.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Green Newtown Pippin	Fair	10		L. W.
Green Winter Pippin, see Green Newtown Pippin				
Green Vandevere, see Vandevere				
Groskoe Selenka Gruner	Good	10		E. S.
Gros Pomier, see Haas				
Haas	Fair	10		F.
Hartford Rose	Few	5		
Holland Pippin	Fair	5		E. W.
Hominy, see Sops of Wine				
Hoss or Horse, see Haas				
Hower or House, see Fall Wine				
Howe's Russet, see Roxbury Russet				
Hubbardston Nonesuch	Few		7	E. W.
Hurlbut	Fair	10		E. W.
Hurlbut Stripe, see Hurlbut				
Jackson Apple, see Chenango Strawberry				
Jacobs Sweet	Few	5		
Jeffries	Good	10		S.
Jeniton, see Rawles Janet				
Jenette, see Rawles Janet				
Jersey Sweeting	Good	10		S.
July Apple, see Primate				
July Pippin, see Early Harvest				
Kentucky Pippin, see Ben Davis				
Kentucky Queen, see Buckingham				
Keswick	Very large	10		E. F.
King Apple, see King of Tompkins County				
King of Tompkins County	Good	10		E. W.
Kittgeskee	Few	4		
Lady Sweet	Few	10		L. W.
Large White Juneating, see Early Harvest				
Late Duchess	Few	5		S.
Lima, see Twenty Ounce				
Longfield	Large	5		E. W.
Lou	Few	5		F.
Lyman's Pumpkin Sweet, see Pumpkin Sweet				

TABLE SHOWING THE YIELD OF APPLES, ETC., IN 1893 — (*Continued*).

NAME.	Yield in 1893.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Magog Red Streak	Few	5		
Maiden Blush	Good	10		F.
Marietta Russet, see Roxbury Russet.				
Maryland Queen, see Haas				
McMahan's White	Few	5		E. W.
Melon	Few	10		W.
Melonen	Few	5		S.
Milding	Few	5		W.
Molly Whopper, see Fallawater				
Monmouth	Good	10		W.
Morgan's Favorite, see Twenty Ounce				
Mother	Few	10		E. W.
Mountain Pippin, see Fallawater				
Musk Spice, see Fall Wine				
Never Fail, see Rawle's Janet				
Newtown Pippin, see Green Newtown Pippin				
New Brunswick, see Duchess of Oldenburg				
New York Pippin, see Ben Davis				
North American Best, see Primate				
Northern Spy	Good	10		L. W.
Norton's Melon, see Melon				
No. 161, *M. Russian*, see Birth				
No. 477, *Dept. Russian*, see Birth				
Ohio Pippin	Few	5		E. W.
Ohio Wine, see Fall Wine				
Oldenburg, see Duchess of Oldenburg				
Ontario	Few	10		W.
Palmer's Greening, see Washington Royal				
Peck's Pleasant	Good	10		E. W.
Peter	Few	5		F.
Petersburgh Pippin, see Green Newtown Pippin				
Pewaukee	Large	10		W.
Pomme Grise	Few	10		E. W.
Pommeroy, see Lady's Sweet				
Pound, see Fallawater				

TABLE SHOWING THE YIELD OF APPLES, ETC., IN 1893 — (*Continued*).

NAME.	Yield in 1893.	Years since top-worked on bearing tree.	Years since tree was planted.	Season at Geneva.
Pomme Grise — (*Continued*).				
Pound Sweet, see Pumpkin Sweet				
Powers, see Primate				
Primate	Very large	10		E. S.
Prince's Harvest, see Early Harvest				
Princess Louise	Fair	5		E. W.
Prussian, see Twenty Ounce				
Pumpkin Sweet	Large	10		F.
Putnam Russet, see Roxbury Russet,				
Queen Ann, see Mother				
Queen, see Buckingham				
Rambo	Very large	10		E. W.
Rawle's Janet	Large	10		W.
Red Beitigheimer	Large	10		E. F.
Red Cheek Pippin, see Monmouth				
Red Pippin, see Ben Davis				
Red Russet	Fair	10		L. W.
Red Vandervere, see Vandervere				
Reinette a feuille d'Acuba, see Acuba-Leaf Reinette				
Reinette de Caux	Few	10		W.
Reschestwenskoe, see Birth				
Rhode Island Greening	Large	10		W.
Rhode's Orange	Fair	4		L. F.
White Pigeon	Fair	5		S.
Washington, see Sops of Wine				
Washington Royal	Good	5		L. W.
Watermelon, see Melon				
White Vandervere, see Vandervere				
Wells, see Domine				
William's Early, see William's Favorite				
William's Favorite	Good	10		E. S.
William's Red, see William's Favorite				
William Prince	Few	4		
Wine Rubets	Few	5		E. S.
Winesap	Fair	10		W.
Winter Blush, see Fallawater				
Winter Queen, see Buckingham				
Workaroe	Few	10		W.
Yellow Transparent	Good	5		E. S.
York Imperial	Good	5		F.

TABLE SHOWING THE YIELD OF APPLES ETC., IN 1893 — (*Continued*).

NAME.	Yield in 1893.	Years since top-worked on bearing tree	Years since tree was planted.	Season at Geneva.
CRAB APPLES.				
Blood Red	Few	5	....	F.
Chicago	Good	5	....	W.
Coral	Fair	10	....	E. W.
Hyslop	Fair	10	...	F.
Lady	Fair	5	...	L. F.
Large Red Siberian	Few	5	....	E. F.
Martha	Few	5	....	F.
Oblong	Fair	10	....	E. F.
Paul's Imperial	Good	5	....	E. F.
Picta Striata	Fair	5	....	E. F.
Red Siberian	Few	5	....	E. F.
September of Gideon	Few	5	...	F.
Transcendent	Large	10	....	E. F.
Whitney No. 20	Good	10	....	S.

PEARS.

LIST OF PEARS IN STATION ORCHARDS IN 1893, NOT INCLUDING STATION SEEDLINGS.

Anna Nellis.
Angouleme.
Anjou.
Ansault.
Arkansas Mammoth.
Assomption.
Autumn Bergamot, *No.* 122.
Ayer No. 1.
Bartlett.
Bartseckel.
Bessemianka.
Bezi de la Motte.
Bordeaux.
Bosc.
Boussock.
Brandywine.
Brignais.
B. S. Fox.
Buffum.
Centennial.
Chinese Sand.
Cincincis.
Clairgeau.
Clapp's Beauty.
Clapp's Favorite.
Cocklin.
Coles.
Columbia.
Congress.
Comet.
Comice.
Craig.

Crow's Choice.
Daimyo.
Dana's Hovey.
Dearborn's Seedling.
Delices de Louvenjal.
Dewey's Premium.
Directeur Alphande.
Dix.
Doctor Reder.
Dula.
Early Bergamot.
Early Harvest.
Easter Beurre.
Ellis.
E. No. 47.
Esperen.
Exeitier.
Fitzwater.
Flat Bergamot.
Flemish Beauty.
Fondante d' Automne.
Fondante de Bihorel.
Fortunee Boisselot.
Frederic Clapp.
Gakovsky.
Gans.
Gansel's Seckel.
Garber.
Gifford.
Goodale.
Hosenschenck.
Howell.
Idaho
Japan Golden Russet.
Jaques Molet.
Jones
Josephine de Malines.
Kieffer.
Kingsessing.
Kinsman.
Kurskaya.
Lamartine.
Late Bartlett.
Lawrence.
Lawson.
Le Conte.
Limbertwig
Lincoln Coreless.
Little Gem.
Longworth No. 1.
Lucy Duke.
Madam Appert.
Madam Millet.
Madam von Siebold.
Manning's Elizabeth.
Marie Benoist.
Marshall.
Maurice Desportes.
Mt. Vernon.
Nickerson.
No. 6.
No. 439.
Old Crassane.
Ontario.
Osband's Summer.
Passans du Portugal.
P. Barry.
Peffer.
Peffer No. 3.
Pitmaston Duchess.
Pound.
Pres. Drouard.
Ravenwood.
Raymond de Montlaur.
Refreshing.
Reliance.
Ritson.
Rutter.
Seckel.
Sheldon.
Shull.
St. Crispin.
Superfin.
Theresa Appert.
Tyron.
Urbaniste.
Van Cott.
Vermont Beauty.
Victor.
White Doyenne.
Winter Bartlett.
Winter Nellis.
Youngken's Favorite.
Zuckerbirn.

Total, 126.

QUINCES.

List of Quinces in Station Orchards in 1893.

D'Alger.
Meech's Prolific.
Rea.
Winter Sweet.
Missouri Mammoth.
Sweet Winter.
Champion.
Total, 7.

PLUMS.

List of Plums in Station Orchards in 1893.

Abundance.
Arab No. 1.
Arab No. 2.
Arab No. 3.
Arch Duke.
Arkansas Lombard.
Batchelor's Damson.
Belle de September.
Blackman.
Bongoume.
Botan.
Bradshaw.
Bryanston's Gage.
Burbank.
Chabot.
Cheney.
Churchill.
Clingstem.
Coe's Golden Drop.
Communia.
Copper.
Czar.
Dame Aubert.
De Caradeuc.
Desoto.
Diamond.
Duane's Purple.
Dunlap.
Early Orange Prune
Early Prolific.
Early Red.
Field.
Forest Garden.
French Damson.
Freestone Damson.
Frogmore Damson.
Garfield.
General Hand.
German Prune.
Guii.
G. No. 44.
Golden Beauty.
Golden Gage.
Goliath.
Grand Duke.
Hawkeye.
Hudson River.
Hudson River Purple Egg.
Huling's Superb.
Hytankio.
Ickworth Imperatrice.
Imperial Gage.
Improved Rocky Mount. Cherry.
Italian Prune.
Japanese Seedling X.
Jefferson.
Kelsey.
King of Damsons.
Lafayette.
Lincoln.
Lombard.
Long Leaf Wonderful.
Lucomb's Nonesuch.
Magnum Bonum.
Maquoketa.
Marcus.
Marianna.
Marianna Seedling.
McLaughlin.
Merunka.
Middleburg.
Miner.

Minnesota.
Missouri Apricot.
Moldovka.
Monarch.
Monroe.
Moore's Arctic.
Moreman.
Newman.
Niagara.
Ogon.
Orange.
Oswego.
Ottoman Seedling.
Oullin's Golden.
Paul's Earliest.
Peter's Yellow Gage.
Pilot.
Poole's Pride.
Pond's Seedling.
Pottawattamie.
Prairie Flower.
Precoce de Berthold.
Prince Engelbert.
Prince of Wales.
Pringle's Blue.
Pringle's Purple.
Prune D'Agen.
Prunus Domestica.
Prunus Pissardi.
Prunus Simoni.
Purple Egg.
Quackenboss.
Quaker.
Reed.
Reine Claude de Bavay.
Robinson.
Rollingstone.
Rood.
Round Leaf Wonderful.
Royal Hative.
Ruby.
Saunders.
Seedling No. 1.
Seedling No. 2.
Shipper's Pride.
Smith's Orleans.
Smith's Prune.
Spaulding.
St. Lawrence.
Stanton.
Strawberry.
Stoddard.
Sweet Damson.
Tobias Gage.
Transparent.
Ungarish Prune.
Union Purple.
Victoria.
Wangenheim.
Washington.
Wayland.
Weaver.
Weedsport German Prune.
Wild Goose.
Wolf.
World Beater.
Wyant.
Wyzerka.
Yellow Gage.
Yellow Japan.
Yellow Voronesh.
Total, 143.

PEACHES.

LIST OF PEACHES IN THE STATION ORCHARDS IN 1893.

Alberge Yellow.
Alexander.
American Apricot.
Amsden.
Atlanta.
Beatrice.
Brevoort.
Bokara, No. 1.
Bokara, No. 3.
Brigden.
Butler's Late.
Capt. Eads.
Caroline Beauty.
Catherine Cling.
Chair's Choice.
Christmas Seedling.

Connett's Early.
Conkling.
Cooledge Favorite.
Crawford's Early.
Crawford's Late.
Crockett's White.
Diamond.
Dr. McGill.
Early Champion.
Early Silver.
Early York.
Elberta.
Ellison.
Ford's Choice.
Foster.
Fox's Seedling.
G. & A.
Globe.
Goshawk.
Haine's Early.
Hale's Early.
Henrietta Landon.
Hill's Chili.
Japanese Early.
Jones' No. 34.
Kendrick's Heath.
Kibby Golden.
Louise.
Magdala.
Malta.
Marcella.
Midseason Favorite.
Millhisen.
Moore's Favorite.
Mountain Rose.
Myer's Seedling.
New Prolific.
North China, No. 2.
Old Mixon Cling.
Ostrander's Early.
Ostrander's Late.
Paul Boynton.
Pendleton.
Piquet's Late.
Pratt.
Princess of Wales.
Prize.
Red Cheek Melocoton.
Rivers.
Royal George.
Salway.
Sargent.
Schumaker.
Sneed.
Stevens' Late.
Steward No. 1.
Steward No. 2.
St. Marie.
Stump the World.
Surpasse Melocoton.
Thurber.
Wager.
Walker's Var. Free.
Ward's Late.
Waterloo.
Wilder.
Willett.
Wonderful.
Woodman's Choice.
Yellow St. John.

Total, 86.

CHERRIES.

List of Cherries in Station Orchards in 1893.

Abbess de Oignies.
Amarelle Bunt.
Auburn Duke.
Bessarabian.
Brusseler Braune.
Catskill.
Cerise de Ostheim.
Cleveland's Bigarreau.
Double Natte.
Downer's Late.
Early Lamaurie.
Esel Kirsche.
George Glass.
Heart Shaped Weichsel.
Ida.
Kentish.
King's Amarelle.
Lithaur Weichsel.

Luelling.
Louis Phillippe.
Lutovka.
May Duke.
Mercer.
Montmorency.
Montmorency Ordinaire.
23 Orel.
26 Orel.
27 Orel.
Reine Hortense.
Rostraver Bigarreau.
Schmidt's Bigarreau.
Sklanka.
Spate Amarelle.
Station Seedling.
Vilne Sweet.
White Caroon.
Windsor.
Wragg.
Yellow Spanish.
Total, 38.

CURRANTS.

LIST OF CURRANTS GROWING AT THIS STATION IN 1893:

Baldwin's Black.
Black Grape.
Black Naples.
Caywood's Seedling White.
Champion.
Champion Black.
Cherry.
Common Black.
Crandall.
Eclipse.
Fay.
Garfield.
Gloire des Sablons.
Jelly.
Lee's Black Prolific.
London Red.
Marvin's Seedling White.
Mills, No. 20.
Mills, No. 22.
Mills, No. 28.
Mills, No. 29.
Missouri Large Fruited.
Moore, No. 23.
North Star.
Prince Albert.
Prince of Wales.
Red Dutch.
Red Flowering.
Ruby Castle.
Saunders' No. 1.
Saunders' No. 2.
Versailles.
Victoria.
White Dutch.
White Grape.
White Versailles.
Wilder.
Total, 37.

GOOSEBERRIES.

LIST OF GOOSEBERRIES GROWING AT THIS STATION IN 1893, NOT INCLUDING STATION SEEDLINGS.

Alderman.
Alice.
Amber.
American.
Antagonist.
Apology.
Bollin Hall.
Beauty.
Berry's Early Kent.
Blucher.
British Oak.
British Queen.
Briton.
Bobby.
Broom Girl.
Bull Dog.
Bury Lane.
Candidate.

Careless.
Catharine.
Champion.
Chautauqua.
Cheerful.
Clayton.
Columbus.
Columbus Seedling.
Countess of Amsdale.
Crank.
Cremore.
Criterion.
Crown Bob.
Crystal.
Cyprus.
Dagwell's No. 1.
Dan's Mistake.
Diadem.
Doctor Wooley.
Dominion.
Downing.
Drill.
Du Bois.
Duckwing.
Duke of Sutherland.
Duster.
Early Sulphur.
Eskender Bey.
Excellent.
Excelsior.
Faithful.
Falstaff.
Fascination.
Flextonia.
Flora.
Freedom.
Frontenac.
Forrester.
Foxhunter.
Galopin.
Garibaldi.
Gipsy Girl.
General.
George Ridley.
Golborne.
Golden Drop.
Golden Hero.
Golden Prolific.
Governor.
Great Rock.
Green Gage.
Greenock.
Green Walnut.
Gretna Green.
Gunner.
Harriet.
Helpmate.
Hero of the Nile.
Highlander.
High Sheriff.
Hit or Miss.
Hospool.
Houghton.
Hue and Cry.
Huntsman.
Improved Early Hedgehog.
Industry.
Ironmonger.
Italy.
Jem Mace.
Jerry.
Jessie.
John Anderson.
John Hall.
Jolly Angler.
Jolly Sailor.
Keen's Seedling.
Keepsake.
King of Trumps.
Lady Houghton.
Lady Popham.
Lady Stanley.
Lancashire Lad.
Largo.
Lavinia.
Leader.
Leveller.
Leviathan.
Lion's Provider.
Lizzard.
London City.
Long Barney.
Look After Me.
Lord Beaconsfield.
Lord Derby.
Lord Leigh.
Lord Rancliffe.
Lord Scarborough.

Lowton.
Magenta.
Major Hibbard.
Marlborough.
Mary Ann.
Matchless.
Mitchell.
Mitre.
Miss Chester.
Monarch.
Monument.
Mountain.
Mount Pleasant.
Mrs. Bowcock.
Mrs. Oldfield.
Mrs. Whittaker.
Nailor.
Nancy.
Napoleon le Grand.
Nottingham.
Overall.
Overseer.
Pale Red.
Pastime.
Pearl.
Peru.
Peto.
Pilot.
Plowboy.
Postman.
President.
Pretender.
Priscilla.
Puyallup.
Queen Anne.
Queen of Trumps.
Queen of Whites.
Queen Victoria.
Red Champaign.
Red Jacket.
Red Robin.
Red Warrington.
Ringer.
Roaring Lion.
Rover.
Rough Red.
Rumbullion.
Shiner.
Sir George Brown.
Slaughterman.
Smiling Beauty.
Smith.
Snowdrift.
Souter Johnny.
Speedwell.
Sportsman.
Stella.
Stockwell.
Strubler, *No.* 1.
Strubler, *No.* 2.
Strubler, *No.* 4.
Strubler, *No.* 5.
Strubler, *No.* 6.
Strubler, *No.* 7.
Strubler, *No.* 10.
Succeed.
Sunset.
Surprise.
Tally Ho.
Thatcher.
Thomas Williams.
Thumper.
Telegraph.
Tichborne.
Transparent.
Triumph.
Trumpeter.
Try Me Oh.
Unity.
Veteran.
Village Green.
Viper.
Visit.
Wakeful.
Watson's Tree.
Weather Cock.
Wellington's Glory.
White Eagle.
White Hare.
Whitesmith.
White Swan.
William Watson.
Wistaston Hero.
Wonderful.
Yaxley Hero.
Yellow Sulphur.

Total, 212.

Variety Tests of Grapes.

Some of the newer varieties of grapes which have fruited in the station vineyards are described below; comment is also made on a few older and better known grapes, and references are given to the reports of varieties which have been noted in previous publications of this station.

The botanical classification of a variety is indicated by an italicized abbreviation of the name of the species to which it belongs.*

A hybrid is indicated by an "X" separating the names of the species of which it is the offspring; thus, *vin.* X. *Lab.* indicates a hybrid of *vinifera* fertilized by *Labrusca.* When it is known to which of the two species the female parent belongs, this parent is named first.

When a hybrid is more closely related to one species than to any other this relationship is indicated by an "X" following the name of the species to which it is most closely related; thus, "*Lab.* X" shows that the hybrid is most closely related to the *Labrusca* species.

The names of the species represented in a hybrid are also frequently given in parentheses following the name of the hybrid; thus, Bailey (*Lab.*, *Lin. vulp.*), indicates that the three species named are represented in the parentage of this variety; Brighton *Lab.* X, (*Lab.*, *Vin.*) indicates that Brighton is a hybrid of *Labrusca* and *vinifera*, with more of *Labrusca* than of *vinifera* blood.

Synonyms are printed in italics and inclosed in parentheses.

Alice. *Lab.* or *Lab.* X. A red grape, juicy, sweet, with some foxy flavor. It ripens evenly in the cluster but the different

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*The following abbreviations are used, viz.: *Lab.* for *Labrusca*, L., the wild Fox grape; *vulp.* for *vulpina*, L. (*riparia*, of Mx.), the wild grape of the river banks; *cand* for *candicans* Engel., the Mustang grape of Texas; *æst.* for *æstivalis*, Mx., the wild Summer grape; *vin.* for *vinifera*, L., the cultivated grape of Europe; *Lin.* for *Lincecumii*, Buck., the Post-oak grape of Texas; *Bourq.* for *Bourquiniana*, Mun.. and *rup.* for *rupestris*, Scheele, the Rock or Sand grape of Western Mississippi Valley and Texas.

clusters vary considerably in their time of ripening. Vine very vigorous; not a heavy bearer so far as tested here. Season about with Concord or a little earlier. See, also, Report of this Station, 1892, p. 613.

Amber. (*vul.*, *Lab.*) Vine vigorous, and moderately productive this season, foliage good. Ripens later than Concord. See, also, Report of this Station, 1892, p. 613.

Amber Queen. This is said to be a seedling of Marion by Black Hamburg. It has continuous tendrils which fact indicate either Labrusca or æstivalis ancestry. Marion has been considered as belonging to the *vulpina* species (*riparia* of Mx.) which does not have continuous tendrils, neither does *vinifera*, the species to which Black Hamburg belongs. See, also, Annual Report of this Station, 1892, pp. 613–614.

Arkansaw. Received from Jos. Hart, Fayetteville, Ark., 1893.

Beagle. *Lab.* X, (*Lab.*, *vul.*). A black grape described in the Report of this Station for 1892, p. 615. Foliage good; vine very strong grower but has not been very productive here. Ripened this season about with Moore's Early.

Black Eagle. *Lab.* X *vin.* As grown here this is a strong vine with good foliage. It can not set fruit of itself but in the station vineyard where it stands near other varieties it is very productive. The clusters are very large and filled with large beautiful black berries. Flesh rich and melting with little pulp. Begins to ripen a little before Worden. See, also, Report of this Station, 1892, p. 616.

Blanco. *Lab.* X, (*Lab.*, *vul.*, *vin.*). Originated by T. V. Munson, Denison, Texas. A seedling of Elvira by Triumph. Bunch rather loose, medium size; berry medium size, purplish red color, moderately tender pulp, sweet, good flavor. Has not proved productive here. See, also, Report of this Station, 1892, p. 616.

Brilliant. *Lab.* X, (*Lab.*, *vin.*, *Bourq.*). Bunch and berry larger than Delaware, not quite equal to Delaware in flavor and quality as grown here. Moderately productive this season.

Berry of a fine red color, sweet, vinous with no foxiness; pulp tender, juicy and of good quality. Season about with Concord or a little earlier. See, also, Report of this Station, 1892, p. 616.

Brown. Received from W. B. Brown, Newburgh, N. Y., 1893.

Campbell. (*Lab., vin.*). This grape produces beautiful large clusters of medium sized white berries. It is too late to ripen well in this locality, being usually somewhat later than Catawba. See, also, Report of this Station, 1892, p. 616.

Canonicus. *Lab.* X, (*Lab., vul.*). See Report of this Station for 1892, p. 617. This year the Canonicus continued its previous good record. While the vine has not been more productive than Worden yet it yields well and may prove a desirable acquisition to the list of white grapes in some localities. Ripens a little before Concord.

Cochee. Received from Stayman & Black, Leavenworth, Kansas, 1893.

Denison. *Lab.* A seedling of Moore's Early that originated with Prof. T. V. Munson, Denison, Texas. So far as tested here it has not been productive enough to be valuable.

Early Ohio. *Lab.* or *Lab.* X. A chance seedling received from C. S. Curtis & Co., Portland, N. Y., 1891. Thus far the vines have been moderately vigorous, and the foliage good. They bore well last season for young vines. Among more than one hundred and forty kinds fruited here this season the Early Ohio was one of the first to ripen its fruit being a few days earlier than Moore's Early. Its fruit was not equal in quality to Moore's Early this season. It is a purple grape.

Eclipse. Received from Stayman & Black, Leavenworth, Kansas, 1893.

Elvicand. *Cand.* X, (*cand., vul., Lab.*). A seedling of Elvira by Candicans that originated with Prof. T. V. Munson, Denison, Texas. In the Report of this Station, 1892, p. 622, it was recommended for further trial. After fruiting it another season the recommendation is repeated. The vine is very vigorous and productive; foliage good; fruit borne in compact handsome dark red clusters; pulp tender, sweet, vinous, juicy. Ripens about with Concord.

Eumelan. (*Lab.*, *vin.*). In the report of this Station for 1892, pp. 603, 605, 623, it was noted that the blossoms of Eumelan were incapable of fertilizing themselves, and therefore this variety should be mixed with other varieties that blossom at the same time. This season the experiments in self-fertilizing the Eumelan were repeated, and two berries were secured from several clusters self-fertilized. While this changes the Eumelan from the class having "pollen self-irritant," as noted on p. 603 of the report referred to, to the class "partly self-fertile," yet so small a proportion of the self-fertilized blossoms set fruit that they are practically unable to fruit when self-fertilized, and therefore the Eumelan should be planted in mixed vineyards to secure the best results.

Geneva. *Lab.* X, (*Lab.*, *vin.*). The fruit of this variety may be kept through the winter. See, also, Report of this Station for 1892, pp. 623, 624.

Herald. *Lab.* or *Lab.* X. One of the earliest black grapes grown at this station. Vine vigorous and productive, foliage good; bunch medium, compact; berry above medium size, poor in flavor and quality. See, also, Report of this Station 1892, p. 625.

Hercules. Of the one hundred and forty-eight varieties of cultivated grapes exhibited by this station at the World's Columbian Exposition in Chicago, none attracted so much attention or elicited so many inquiries as the Hercules. Probably this was due to its resemblance to well-grown Black Hamburg. The berries are very large; clusters large, sometimes shouldered. Last season the fruit cracked and dropped badly, but these faults did not appear this season. The pulp is rather juicy, not tender and does not readily release the seeds. The flavor is good. The vine is very vigorous and productive. It develops very large leaves as well as very large fruit. Season about with Concord.

Hopican. *Lab.* X, (*Lab. vin.*). Another season's trial confirms the previous record of this variety. So far as tested here it has not proved worthy of cultivation. See Report of this Station, 1892, p. 626.

Isabella Seedling. (*Lab.*) Foliage good, vine vigorous and productive. Fruit resembles Isabella in many respects but ripens a little later than Moore's Early — about two days later this season. See Report of this Station for 1892, p. 636, "Seedling of Isabella."

Leavenworth. (*Stayman & Black's, No.* 47.) *Lab.* A white Concord seedling received in 1889. It bore its first few clusters of fruit this season. Fruit dull greenish yellow with thin bloom; ripens about with Worden. Pulp juicy, tender, sweet or nearly so, slightly vinous, not high quality.

Lindmar. *Lab.* X, (*Lab., vin.*). A seedling of Lindley by Martha, originated by Prof. T. V. Munson, Denison, Tex., and sent to this station for testing in 1886. Vine vigorous and productive. The average yield of four vines in 1893 was eight pounds and five ounces per vine. Season about with Concord. Cluster medium size, berry medium size, dull pale green, nearly destitute of bloom; skin thin, tender, pulp moderately tender, juicy, agreeable, slightly vinous flavor, good quality but not equal to Diamond as grown here. Can not yet see any reason for its cultivation in this section. See, also, Annual Report of this Station for 1892, p. 628.

Magnate. Received in 1893 from Stayman & Black, Leavenworth, Kans.

Mendota. Received in 1893 from Stayman & Black, Leavenworth, Kansas.

Mills. *Vin* X, (*Vin. Lab.*). A seedling of Muscat Hamburgh by Creveling. Vine vigorous and very productive of beautiful, large, black clusters. Bunch shouldered, compact; berry large, black, covered with bloom; skin thick; pulp firm but not tough, meaty, juicy with a peculiar flavor not agreeable to some. Seeds large and long, similar to those of Agawam. Ripens with Concord or a little later.

Olita. (*Bourq., Lab.*) The report of this station for 1892 recommended the trial of Olita as a table grape. This season it has sustained its former good record. It was as productive as

Delaware, of which it is a seedling. Ripened this season before Concord. Bunch and berry somewhat larger than with Delaware; color an attractive pale yellowish green; skin thin, tough, covered with abundant bloom; pulp juicy, vinous, nearly or quite melting, of good quality and agreeable flavor; vine vigorous; foliage good.

Omega. Received in 1893, from Stayman & Black, Leavenworth, Kansas.

Opal. (*Lab. vin.*). A white seedling of Lindley received in 1886, from Prof. T. V. Munson, Denison, Texas. It is late and unproductive so far as tested here. See Report of this Station 1892, p. 632.

Osage. Received from Stayman & Black, Leavenworth, Kansas, 1893.

Ozark. Received from Stayman & Black, Leavenworth, Kansas, 1893.

Paradox. *Lab.* A seedling of Hartford by Iona, sent to the Station 1889 by W. D. Barns, Middlehope, N. Y. Vine moderately vigorous and productive; foliage good; clusters medium or above, moderately compact, frequently double-shouldered; berry medium size, dark purple with blue bloom, juicy, somewhat vinous, pure flavored, good quality. Season somewhat earlier than Concord being about with Worden this year. See, also, Report of this Station 1892, p. 632.

Paragon. (*Burr's No.* 15.) *Lab. or Lab*, X. A chance seedling received here in 1888. Vine moderately vigorous, not so productive as Concord though it yields well. Season about with Concord or earlier. Cluster medium; berry medium, black; pulp moderately tough, juicy, somewhat vinous, good flavor and as good quality as Concord. See, also, Report of this Station 1892, p. 632.

Pearl. (*Vul. Lab.*) A white grape of Concord season or later. Cluster medium, compact; berry medium, white tinged with yellow. It has not usually been productive here, but this season the two vines averaged ten pounds of fruit for each vine. See, also, Report of this Station for 1892, p. 632.

Perfection. Received in 1893, from Stayman & Black, Leavenworth, Kansas.

Pulaski. Received in 1893, from Stayman & Black, Leavenworth, Kansas.

Randall. A white wine grape, originated more than twenty years ago as a chance seedling in the garden of Mr. Randall, Bayonne, N. J., and sent to this station in 1893, by Peter Henderson & Co., New York, N. Y., who furnished the following description: "Bunches large, often shouldered; berries very large, red or maroon color; skin thick; little pulp; sweet and has the aroma of wine; wood long jointed, pretty hard; ripens before Concord. It is not injured by Phylloxera but is subject to mildew."

Roenbeck. (*Vin.?*) A chance seedling received from Peter Henderson & Co., New York, N. Y., in 1893, who furnish the following description: "First fruited in 1870. Bunches long, compact, well shouldered. Berries pale green, medium to large, with no pulp, melting, sweet. Skin thin, transparent. Ripens about with Concord. Wood short jointed and of light gray color. Vine hardy and prolific. It evidently descended from the vinifera species, yet the root withstands Phylloxera."

Rustler. *Lab.* X, (*Lab vin.*). A white seedling of Lindley by Martha. Cluster medium; berry medium or above, white; pulp, sweet, juicy, tough, inferior to Diamond in quality; season about with Concord; vine vigorous; foliage healthy. It was received in 1888 from Prof. T. V. Munson, Denison, Texas. It has not been very productive here.

Trask. A chance seedling that first fruited in 1875. Received in 1893 from Peter Henderson & Co., New York, N. Y., who furnish the following description: "Vine not injured by Phylloxera and has not been known to mildew. Leaves smooth. Bunches large, long, often shouldered. Berries medium to large, brown or bluish black when fully ripe, without pulp, tender, melting, very sweet, vinous flavor. Ripens before Concord."

White Imperial. Received in 1893 from Stayman & Black, Leavenworth, Kansas.

LIST OF GRAPES GROWING IN THE STATION VINEYARDS IN 1893, NOT INCLUDING STATION SEEDLINGS:

Adirondack.
Agawam.
Aledo.
Alexander Winter.
Alice.
Amber.
Amber Queen.
Ambrosia.
America.
Aminia.
Antoinette.
Arkansaw.
Arnold's No. 16. See Canada.
August Giant.
Bacchus.
Bailey.
Barry.
Beagle.
Berckmans.
Bertha
Big B. Con.
Big Extra.
Big Hope.
Big Red. See Dr. Collier.
Black Delaware. See Nectar.
Black Eagle.
Blanco.
Brighton.
Brilliant.
Burnet.
Burr No. 15. See Paragon.
Burr No. 19. See White Jewel.
Campbell.
Canada.
Canonicus.
Carman.
Catawba.
Cayuga.
Centennial.
Champion.
Chandler.
Chautuaqua.
Clevener.
Clinton.
Cochee.
Colerain.
Concord.
Cortland.
Cottage.
Creveling.
Croton.
Daisy.
Delaware.
Denison.
Diamond.
Diana.
Doctor Collier.
Doctor Hexamer.
Doctor Warder.
Downing.
Dracut Amber.
Duchess.
Early Dawn.
Early Market.
Early Ohio.
Early Victor.
Eaton.
Eclipse.
Eldorado.
Elsinburgh.
Elvibach.
Elvicand.
Elvira.
Emma.
Empire State.
Essex.
Esther.
Etta.
Eumelan.
Faith.
Fern Munson.
Frances B. Hayes. See Hayes.
Gaertner.
Geneva.
Glenfeld.
Gold Dust.
Golden Grain.
Gov. Ross.
Green Mountain. See Winchell
Grein's Golden.
Hartford.
Hartford Prolific. See Hartford.
Hayes.
Herald.
Herbert.
Hercules.
Hermann Jaeger.
Highland.

Hopican.
Hopkins.
Illinois City.
Iona.
Isabella.
Janesville.
Jefferson.
  Jennie May. See Concord.
Jessica.
Jewel.
  Jordan. See Moyer.
Juno.
Lady.
Lady Washington.
Leader.
Leavenworth.
Lindley.
Lindmar.
Linn
Little Blue.
Livingston.
Lutie.
Mabel.
Magnate.
Marie Louise.
Marion.
  Mary. See Lindley.
Mary's Favorite.
Massasoit.
Mathilde.
Maxatawney.
Mendota.
Merrimack.
Metternich.
Mills.
Missouri Riessling.
Monroe.
Montefiore.
Moore's Early.
Nectar.
Niagara.
Noah.
Northern Muscadine.
Norwood.
Olita.
Omega.
Oneida.
Opal.
Osage.
Ozark.
Paradox.
Paragon.
Pearl.
Perfection.
Perkins.
Pocklington.
Poughkeepsie Red.
Prentiss.
Profitable.
Pulaski.
Randall.
Reagan.
Rebecca.
Red Bird.
Red Eagle.
Requa.
Rochester.
Rockwood.
Roenbeck.
  Rogers No. 3. See Massasoit.
  Rogers No. 4. See Wilder.
Rogers No. 5.
  Rogers No. 9. See Lindley.
Rogers No. 13.
  Rogers No. 14. See Gaertner.
  Rogers No. 15. See Agawam.
  Rogers No. 19. See Merrimack.
Rogers No. 24.
  Rogers No. 28. See Requa.
Rogers No. 32.
  Rogers No. 39. See Aminia.
  Rogers No. 41. See Essex.
  Rogers No. 43. See Barry.
  Rogers No. 44. See Herbert.
  Rogers No. 53. See Salem.
Rommel.
Roscoe.
Rustler.
Rutland.
Salem.
Seedlings unnamed.
  Caywood No. 50.
  Edmeston No. 1.
  No. 2, J. Shull.
  No. 2, Gerbig.
  No. 2, J. T. Thompson.
  No. 5, J. T. Thompson.
  No. 10, Gerbig.
  No. 42c, J. G. Burrow.
  Seedling of Isabella from G. A. Ensenberger, Sr.
  White from D. S. Marvin.
Senasqua.

Standard.
Stayman & Black's No. 47. See Leavenworth.
Telegraph.
Trask.
Triumph.
Ulster Prolific. See Ulster.
Ulster.
Vergennes.
Victoria.
Vitis æstivalis, Mx.
Vitis Arizonica, Engel.
Vitis Berlandieri, Planch.
Vitis Bourquiniana, Munson.
Vitis candicans, Engel.
Vitis Champini, Planch.
Vitis cinerea, Engel.
Vitis cordifolia, Mx.
Vitis Doaniana, Mun.
Vitis Labrusca, L.
Vitis Lincecumii
Vitis monticola, Planch.
Vitis mustangensis, Buckl. See V. candicans.
Vitis Novo-Mexicana, Munson. See V. Solonis.
Vitis Palmata, Engel. See V. rubra.
Vitis Romaneti, Planch.
Vitis rotundifolia, Mx.
Vitis riparia, Mx. See V. vulpina.
Vitis rubra, Mx.
Vitis rupestris, Scheele.
Vitis Solonis, Sou.
Vitis vulpina, L.
Wheaton.
White Imperial.
White Jewel.
Wilder.
Winchell.
Witt.
Woodruff Red.
Worden.
Wyoming Red.

Total 210

VARIETY TESTS OF BLACKBERRIES.

Blackberries grown at this station are on rather stiff clay loam well tile-drained and made fertile with stable manure. They are given no winter protection, so that their comparative hardiness may be the more readily determined. The lowest temperature experienced here last winter, 1892 3, was six degrees below zero, Fahr.

Agawam. Canes stout, vigorous; prickles comparatively few and small. Slightly injured by the winter. One of the most desirable varieties thus far tested at this station. Ranks fourth in productiveness here in 1893. Fruit medium or above, bright black, juicy, sweet, good in flavor and quality.

Ancient Britton. Canes strong and upright, with an abundance of large prickles. Fruit not quite so large as that of Agawam but sweeter, more juicy and of very good flavor. Ranks second in productiveness at this station in 1893.

Barnard. Canes vigorous, strong, with numerous prickles. Fruit medium or above, nearly sweet, very good flavor, resembling Snyder in this as well as in the tendency of some of the fruits to dry before ripening. The last annual report of this station speaks favorably of it as a new variety, but this year it ranks thirteenth as to yield.

Carlo. Canes vigorous, arched, bearing slender branches and comparatively few and small prickles. Fruit small, with large grains, juicy, slightly subacid, fair flavor. Ranks ninth as to productiveness for 1893.

Dorchester. This variety was introduced over forty years ago. It is still catalogued by nurserymen and does well in some localities. At this station in 1893 it ranked first in yield. Canes vigorous, upright, with numerous strong prickles. Fruit medium or above, good color, sweet, juicy, good in flavor and quality.

Early Cluster. Canes upright, moderately vigorous, prickles rather slender and not very abundant. Fruit small to medium, with small compact grains, moderately juicy, nearly sweet, good in flavor and quality, very early.

Early Harvest. This variety, introduced several years ago, has sometimes been injured by the winters here. Last winter about ten per cent of the bearing wood was injured. It ranks third in productiveness for 1893. Mature canes are red, moderately vigorous; prickles comparatively few and small. Fruit medium size, very juicy, sweet, fine flavor, very good quality.

Early Mammoth. *Thompson's Early Mammoth.* (*From Cleveland Nursery Co., Lakewood, O.*, 1888.) One season the plants were killed to the snow line and last winter fifty per cent of the canes were injured. Canes vigorous, arched, quite red when mature; prickles numerous and slender. Berries small to very large, often imperfect, bright black, with large grains, very juicy, slightly subacid, good flavor and very good quality. Ranks tenth in productiveness for 1893.

Eldorado. (*From E. M. Buechley, Greenville, O.*, 1890.) Canes moderately vigorous, with numerous large prickles. Fruit medium size, fair flavor, sweet, juicy, good quality; grains medium to large. Has not been tested long enough to determine its merits in this locality. Ranks twentieth in productiveness for 1893, but the plants are not yet in full bearing.

Erie. (*From Wm. Parry, Parry, N. J.*) Canes rather tender, nearly upright, vigorous, much branched; mature canes green, lightly tinged with red; prickles moderately abundant.

Fruit medium to large, nearly globular, moderately juicy, nearly sweet, good in flavor and quality. Ranks sixteenth in productiveness for 1893.

Evergreen. *Oregon Evergreen.* (*From J. M. Ogle, Puyallup, Wash.*, 1888.) This belongs to a species quite distinct from that of the common varieties of cultivated blackberries. It is known to botanists as *Rubus laciniatus*, Willd. The flowers are of a pale lilac tint, *calyx segments prickly; somewhat leafy; reflexed at apex; leaflets three to five, dissected and sharply serrated, puberulous beneath. Stems nearly terete, straggling. Prickles dilated at base. It is a species indigenous to central Europe. Dr. N. L. Britton informs us that it occasionaly escapes from cultivation along the Atlantic sea board.

Fruit small, with firm grains and hard core, subacid, inferior to any of our commonly cultivated varieties either of the high blackberry *Rubus villosus*, Act. or of the dewberries *R. Canadensis*, L. or *R. trivialis*, Mx. The canes were killed to the ground last winter, but a rank growth of new canes was produced during the summer.

Plants of this same species were received last spring from Samuel Wilson, Mechanicsville, Pa., under the name of Oregon Evergreen. In Mr. Wilson's catalogue for 1893, it is described as extremely hardy, very productive and of excellent quality. He quotes a testimonial from Oregon stating that fully five bushels of fine berries were produced from one plant in one season.

Such results have not been secured at this station with the Evergreen. Although the plants which were set here in 1888 blossomed quite fully this season, they ripened but few fruits and what fruit did ripen, as just stated, was of poor quality.

Lawton, see **New Rochelle.**

Lincoln. Canes, vigorous, upright, with many strong prickles. Fruit small, good quality, juicy, sweet. Many berries are imperfect. Unproductive. Of no value here.

Lovett. *Jewett.* (*From J. T. Lovett, Little Silver, N. J.* 1890.) Canes slightly injured by the winter, vigorous, upright, with many strong prickles. Fruit small to medium, juicy, good quality, nearly sweet; many imperfect berries. Unproductive here.

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*Dict. Gard. Vol. III, p. 331.

Luther. A chance seedling found on the grounds of R. D. Luther, Fredonia, N. Y., and sent to this station for testing in 1891. Canes strong, arched, with rather pale red bark and numerous slender prickles; slightly injured by the winter.

Fruit medium size, juicy, good quality, nearly sweet. Ranks eleventh in productiveness this year but the plants are probably yet too young to produce a full crop.

Minnewaski. (*From A. J. Caywood & Son, Marlboro, N. Y.*, 1889.) A cross of Kittatinny and a wild blackberry.

It is rather tender here. Sixty-five per cent of the canes were killed by the winter. Mature canes lightly shaded with red, much branched, bearing numerous prickles. Fruit medium or above, nearly globular, sweet, juicy, good in flavor and in quality. Ranks thirteenth in productiveness for 1893. In 1890 it was noted *as a late berry of average productiveness.

New Rochelle. *Lawton.* A wilding introduced many years ago. In many localities it is reported as tender but it has been grown for ten years at this station and is nearly hardy so far as tested here. Canes stout, bearing numerous strong prickles. Fruit medium to large, juicy, nearly sweet, good in flavor and in quality. Ranks sixth in productiveness for 1893.

Oregon Evergreen, see **Evergreen.**

Snyder. Valued in some localities as a home and market berry on account of its hardiness, productiveness and good quality. Its fruit is small to medium in size and sometimes dries before ripening. It has usually succeeded fairly well here but this season it ranks eighteenth in yield. Fruit juicy, of fine flavor and good quality. Canes stout, upright, with an abundance of large prickles.

Stone's Hardy. A chance seedling from Illinois, introduced several years ago. Canes upright, rather slender, bearing numerous long prickles. Fruit medium size, juicy, nearly sweet, good in flavor and in quality. Seems to be hardy here. Ranks eighth in productiveness for 1893.

Thompson's Early Mammoth. See **Early Mammoth.**

Taylor. *Taylor's Prolific.* Seems to be hardy here. Mature canes pale green, slightly tinged with red and bearing numerous rather slender pickles. Fruit small to medium, grains medium to large, moderately juicy, nearly sweet, very good flavor, good quality. Ranks fifteenth in productiveness for 1893.

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* C. E. Hunn, Report of this station for 1890.

Wachusett. Canes moderately stout, purplish red when mature; prickles very few and small. Fruit small, very good flavor, juicy, sweet, good quality. Ranks eleventh in productiveness for 1893.

Wilson's Early. Originated about forty years ago in Burlington county, N. J. It is not quite hardy here. Canes moderately vigorous, low, arching, having red bark when mature and numerous small prickles. As grown here many of its fruits are imperfectly filled and the berries vary from small to large. The fruit is composed of large grains and is juicy, sweet and of good quality. Ranks nineteenth in productiveness for 1893. In some seasons it has been much more productive here than in 1893.

Wilson Junior. Originated by William Parry, Parry, N. J., in 1875, from selected seed of Wilson's Early, which it much resembles. Fifty per cent of its canes were winter killed last winter while not more than fifteen per cent of the canes of Wilson's Early were injured. Canes much like those of Wilson's Early, but with less red color in the bark. Berries medium to very large, with large grains; sometimes imperfect and with hard core. Fruit very juicy, very good in flavor and quality. Ranks seventeenth in productiveness for 1893.

The following is a list of varieties recently received. None of them has fruited here:

BLACKBERRIES RECENTLY PLANTED AT THIS STATION.

Black Chief, from I. H. Haynes, Delphi, Ind., 1893.

Early King, from Ellwanger & Barry, Rochester, N. Y., 1892.

Early Mammoth, from Cleveland Nursery Co., Rio Vista, Va., 1892. See also Early Mammoth, page 627.

Ford's No. 1, from Frank Ford & Son, Ravenna, O., 1892.

Fruitland, from W. N. Scarff, New Carlisle, O., 1892.

Mersereau's Seedling, from J. M. Mersereau, Cayuga, N. Y., 1893.

Ohmer, from N. H. Albaugh, Tadmor, O., 1892.

Oregon Evergreen, from Samuel Wilson, Mechanicsville, Pa., 1893. See Evergreen, page 628.

Reyner, from S. R. Alexander, Bellefontaine, O., 1892.

Success, from L. W. Carr & Co., Erie, Pa., 1892.

Woodland, from W. H. Phillip, Staunton, Ind., 1892.

The following table shows the yield of the blackberries fruited at this station in 1893. Five hills of each variety were originally set. No winter protection has been given in any instance and therefore with some tender varieties which have been partially killed out, the yield given is for the remnant of the original five hills. The date when the plants were set is also stated, so that the difference in age may be noted when comparing varieties.

TABLE I. YIELD OF BLACKBERRIES, 1893.

Rank as to yield.	When set.	NAME.	Yield of five hills. Ounces.	In marketable condition.
4	1888	Agawam	188	July 28 to August 23
2	1889	Ancient Britton	232	“ 28 “ 19
13	1888	Barnard	27	“ 31 “ 12
9	1890	Carlo	52	“ 28 “ 15
1	1889	Dorchester	274	“ 28 “ 12
	1889	Early Cluster		
3	1889	Early Harvest	200	“ 28 “ 19
10	1888	Early Mammoth (Thompson's)	35	“ 28 “ 12
20	1890	Eldorado	9	“ 28 “ 4
16	1889	Erie	23	“ 28 “ 19
23	1888	Evergreen. *Oregon Evergreen*	A few fruits	
		Jewett. See Lovett.		
		Lawton. See New Rochelle.		
22	1889	Lincoln	1	“ 28 “ ..
21	1890	Lovett. *Jewett*	6	August 12 “ 15
11	1891	Luther	30	July 28 “ 12
13	1889	Minnewaski	27	“ 31 “ 15
6	1889	New Rochelle. *Lawton*	89	“ 28 “ 15
		Oregon Evergreen. See Evergreen.		

18	1888	Snyder	3	"	31	"	12
8	1888	Stone's Hardy	61	"	31	"	19
		Thompson's Early Mammoth. See Early Mammoth.					
15	1888	Taylor. *Taylor Prolific*	24	"	28	"	12
11	1889	Wachusett	30	"	28	"	12
19	1888	Wilson's Early	10	"	28	"	15
17	1888	Wilson Junior	18	"	28	"	15

The most productive blackberry at this station in 1893 was Dorchester, an old variety which is esteemed in some localities for its productiveness and for the good quality of its fruit. Ancient Britton, which for 1893 ranks second, yields medium size fruits of excellent quality. Early Harvest has also made a good record here except that it is sometimes injured by winter. Agawam, fourth in productiveness for 1893, succeeds well on this soil and is considered one of the most valuable varieties thus far tested at this station. Snyder has usually done well here but this season, for some unknown reason, it has been quite unsatisfactory.

VARIETY TESTS OF DEWBERRIES.

The dewberries grown at this station are given no winter protection. The canes lie prostrate on the ground where they are partially covered by snow. With this treatment from twenty-five to thirty per cent of the Bartel and Mammoth canes were winter killed last winter, and Lucretia lost about one-fourth of its bearing wood from the same cause. The fruit of the Bartel and Mammoth as grown here are very similar and the general habit of growth is much the same. Their fruiting season is somewhat shorter than that of Lucretia, and in quality they are inferior to that variety. The following table shows the yield of these three varieties in 1893:

TABLE II—YIELD OF DEWBERRIES, 1893.

Rank as to yield	When set.	NAME.	Yield of five hills.	In marketable condition.
1893.			Ounces.	
3.....	1888	Bartel...............	72	July 19 to 31.
1.....	1888	Lucretia..............	112	July 19 to August 4.
2.....	1888	Mammoth	75	July 19 to 27.

Comparing this table with table I, it is seen that the dewberries are in marketable condition about ten days before blackberries ripen to any extent. Their fruit is very juicy and refreshing, but inferior in flavor and quality to that of the blackberries.

Bauer. Two varieties of the dewberry were received at this station for testing in 1890, from J. C. Bauer, Judsonia, Ark. Mr. Bauer says he is not introducing either of these varieties and neither of them has been named. They are too tender for this locality, at least without winter protection. They have been killed nearly to the ground each winter since they were set and therefore have not fruited here. One has green bark, hairy and prickly, with characters of the southern dewberry, *Rubus trivialis.* The other is remarkable for its purple tinged foliage. Its young canes have many prickles and are densely covered with long, reddish purple hairs, not stiff enough to be called bristles.

VARIETY TESTS OF RASPBERRIES.

Sixty-six varieties of raspberries, fruited at this station in 1893, six of them for the first time. Of the former number seven are purple, nine are yellow (white), nineteen are black and thirty-one are red. It is thought best in this report to group the raspberries according to the color of their fruit, and to note the botanical classification in the text whenever it seems desirable.

Raspberries are grown at this station on fertile, well-drained clay loam. The land slopes gently to the south. The plants have heretofore been cultivated in hills and given clean culture throughout the season. The old wood has been removed in the fall. Except when expressly otherwise stated the notes given below are based on the characters of the plants as observed at this station. The rank as to yield is given for each group separately, that is to say, red berries are compared as to yield only with red berries, purple berries with purple berries, etc.

BLACK RASPBERRIES.—NOTES ON VARIETIES.

Rubus Occidentalis, L.

Ada. (*From M. Crawford, Cuyahoga Falls, Ohio,* 1888.) Fruit in 1893 was small, firm, of fair quality and nearly sweet. It ranked eleventh in productiveness. No other variety this year gave so large a per cent of its yield late in the season as did Ada but the amount of fruit produced was comparatively small. The station notes for 1890 state that * "the growth was very vigorous and that the plants were of more than average productiveness; season late; fruits usually large, firm and very showy." *In 1891 it was noted as the latest black raspberry fruited that year.

American Everbearing. *From Cleveland Nursery Co., Rio Vista, Va.*, 1892.) Fruit medium or above, moderately firm, juicy, mild, subacid, but nearly sweet when fully ripe; mid season. First picking July 8, last picking July 20. Also the last of August and through September a considerable amount of fruit was produced. This being the first crop the productiveness is not given.

Arctic. (*From unknown donor*, 1892.) Fruit mid season, medium to large, moderately firm, juicy, sweet. Productiveness not given since this is the first crop.

Brackett's 101. See **Lotta.**

Carman. (*From G. H. & J. H. Hale, South Glastonbury, Conn.*, 1888.)

Ranked seventh in yield for 1893. It gave more than one-fifth of its crop early in the season and the greater part of its fruit was picked before the Ohio came fully into its fruiting season. Its fruit was medium in size, firm, mild subacid, moderately juicy, good in quality and in flavor. The station notes for 1890 say,* "a good variety to plant for extra early; fruits of good size, fine color, high flavor, borne in large clusters that had but few fruits blasted." *In 1891 it was called the earliest black raspberry tested that season.

Earhart. *Earhart Everbearing.* (*From G. H. & J. H. Hale, South Glastonbury, Conn.*, 1889.) The first variety to ripen its fruit at this station in 1893 it was also the most unproductive. Fruit medium size, dull black color, neither very juicy nor pulpy, firm, crumbling, sweet and of good flavor. A chance seedling found in the woods in Mason Co., Ills., in 1870.

Ebony. (*From W. W. Farnsworth, Waterville, Ohio*, 1890.) Plants vigorous. Fruit mid season, medium to large, firm, very seedy, moderately juicy, sweet, good quality. It ranked tenth in productiveness for 1893.

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* C. E. Hunn, in reports of this station for 1890 and 1891.

Hale's Early. (*From G. H. & J. H. Hale, South Glastonbury, Conn.*, 1888.) Fruit medium early in 1893, medium size, firm, seedy, moderately juicy, sweet, very good flavor. It ranks twelfth in yield for 1893. Notes of this station in a previous season call it "a vigorous grower, bearing small fruits with a white bloom which detracts from the attractiveness of its color; clusters large with many fruits blasted."

Hilborn. (*From F. R. Palmer and Son, Mansfield, Ohio*, 1889.) A chance seedling originated on the grounds of W. W. Hilborn, Leamington, Ontario. In 1890, the first year it fruited at this station, it was noted* as a "sturdy grower, producing large slightly conical fruits, season medium to late." In 1891 † it was the most productive black raspberry tested at this station. This year, 1893, it ranked third in productiveness, bearing moderately firm, juicy fruit, medium to large size, sweet and very good in flavor and quality. This variety seems to be worthy extended trial on account of its productiveness, vigor and excellent fruit.

Lotta. *Brackett's, No.* 101. (*From G. C. Brackett, Lawrence, Kan.*, 1890.) Fruit large, handsome bright black color, firm, moderately juicy, sweet, somewhat seedy, very good in quality; mid-season. It ranks ninth in productiveness in 1893.

Lovett. (*From J. T. Lovett, Little Silver, N. J.*, 1890.) Originated with Mr. Ezra Wood, Jefferson Co., Ind., and introduced in 1891 by J. T. Lovett & Co., Little Silver, N. J. When first fruited at this station in 1891 it was reported as† "one of the earliest varieties; fruit firm and of good size; growth vigorous." In 1893 it ranked eighth in productiveness. It was medium early, yet had ripened one-half its fruit by the time the Ohio gave its first picking. Fruit large, fine black color, moderately juicy, firm, sweet and of very good quality.

Mills No. 1. (*From Chas. Mills, Fair Mount, N. Y.*, 1891.) Seedling of Gregg (X. Tyler?). Growth very vigorous, slightly injured at the tips by the winter. Fruit large, firm, seedy, moderately juicy, sweet and of good flavor and quality. Ranks fifth on the list for productiveness in 1893 and second only to Mills No. 15 in the amount of fruit produced late in the season.

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* C. E. Hunn, in report of this station for 1890.

† C. E. Hunn, in report of this station for 1891.

Mills No. 7. (*From Chas. Mills, Fair Mount, N. Y.*, 1891.) Seedling of Gregg (X. Tyler?). Growth very vigorous; tips of canes slightly injured by winter. Fruit large to very large, moderately juicy, sweet, good in flavor and quality. *The most productive blackcap on the station grounds in* 1893, and in the whole raspberry plantation exceeded in yield only by Shaffer and Columbian. First fruit picked July 10; last picking Aug. 1; four-fifths of the crop was picked within the six days from July 14 to July 19 inclusive. It seems to be worthy extended trial. So far as tested here it has proved to be a desirable acquisition to the black raspberry list on account of its very large size, fine appearance, good quality and productiveness. It appears to be as hardy as Shaffer.

Mills No. 15. (*From Charles Mills, Fair Mount, N. Y.*, 1891.) Seeding of Gregg (X. Tyler?). Growth very vigorous; canes injured by winter twice as much as were those of Mills No. 7. Fruit medium to large, firm, fine flavored, juicy, sweet, very good to best in quality. In productiveness it ranked second on the list in 1893 and *in yield of late fruit it stood first.* First fruit ripe July 7; first picking July 10; last picking August 1. It appears to be less desirable than Mills No. 7, because it is hardly so productive, more tender in winter and produces smaller fruit; the fruit is of finer flavor and quality than that of No. 7. Further testing is necessary to determine more fully the comparative value of these two varieties.

Older. (*From Coe & Converse, Ft. Atkinson, Wis., and R. D. McGeehon, Atlantic, Iowa,* 1892.) Fruit mid-season, large, firm, moderately juicy, rich subacid. Rank as to yield not given since this is its first crop.

Smith's No. 2. (*From B. F. Smith, Lawrence, Kansas,* 1889.) Rank as to yield can not be given since we have but one plant of this kind. Fruit medium size, firm, juicy, sweet, very good in flavor and quality.

Smith's Purple is apparently a black raspberry of purple color. In everything but the color of its fruit it strongly resembles *Rubus occidentalis*, L. It is noted below under the purple raspberries.

Smith's Prolific. (*From Ezra G. Smith, Manchester, N. Y.,* 1889.) In previous years it has made a good record here but this season it has failed to hold its former high rank in productiveness. The canes were damaged at least thirty per cent by the winter while other black raspberries in the same plat remained uninjured. In 1891 it ranked second in productiveness; this season (1893) it ranked thirteenth.

Fruit bright black color, medium to large, very seedy, not very pulpy, moderately juicy, sweet and of good quality.

Spry's Early. (*From Coe & Converse, Fort Atkinson, Wis.,* 1888.) Plants vigorous; fruit medium size, good black color, firm, juicy, nearly sweet, of very good flavor and quality. In productiveness in 1893 it ranked fourth, and as an early variety it took the lead of all black raspberries tested here this season. In 1890 it was noted "as an abundant cropper of vigorous growth,"* and in 1891 was noted * as "not early."

Winona. (*From R. Johnston, Shortsville, N. Y.*) Fruit midseason, large, juicy, firm, sweet, good quality. Rank as to yield not given as this is its first crop.

TABLE III.— SHOWING RELATIVE PRODUCTIVENESS AND EARLY AND LATE YIELD OF BLACK RASPBERRIES IN 1893.

Rank as to yield, 1893.	NAME.	When set.	Per cent of crop picked prior to July 10.	Per cent of crop picked after July 20.	Yield of five hills—Ounces.
11	Ada	1888	0	50	101
7	Carman	1888	22	6	150
15	Earhart	1889	17	0	48
10	Farnsworth's Seedling	1890	0	9	111
12	Hale's Early	1888	0	12	90
3	Hilborn	1889	0	10	245
9	Lotta	1890	0	15	136
8	Lovett	1890	0	9	148
5	*Mills No.* 1	1891	0	42	207
1	*Mills No* 7	1891	0	19	461
2	*Mills No.* 15	1891	0	25	416
6	Ohio	1890	0	27	180
13	Smith's Prolific	1889	0	9	70
4	Spry's Early	1888	27	6	237

EARLY BLACK RASPBERRIES.

In 1893 the greater part of the black raspberry crop at this station ripened within the eleven days from July 10 to July 20, inclusive. Those kinds which ripened a considerable portion of their crop prior to July 10 are classed as "early," while those which ripened a considerable portion of their crop after July 20 are called late for this season. With this standard in view a consideration of table III shows but three varieties on the list which were early in 1893. Ranked according to their yield up to July 10 these three varieties stand:

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* C. E. Hunn, in report of this station for 1890 and notes for 1891.

TABLE IV.— EARLY BLACK RASPBERRIES RANKED ACCORDING TO YIELD PRIOR TO JULY 10.

NAME.	Date of first picking.	Ounces yielded before July 10.	Total yield in ounces.	Rank as to total yield 1893.
Spry's Early	July 8	64	237	4
Carman	July 8	33	150	7
Earhart	July 6	8	48	15

Spry's Early has made a good record here this season, being not only early but also very productive. Carman also proves to be a desirable early sort. Except in its earliness, Earhart, as grown here, has failed to develop any points of superiority over standard varieties. Not only is it unproductive, but its fruits are not superior in quality, and their dull color renders them unattractive.

LATE BLACK RASPBERRIES.

As explained above in discussing early black raspberries, those kinds which ripened a considerable portion of their crop after July 20 are classed as "late" for this season. An examination of table III, shows that four varieties yielded more than one-fifth of their crop after July 20. Ranked according to the amounts yielded after July 20, these four varieties stand:

TABLE V.— LATE BLACK RASPBERRIES RANKED ACCORDING TO YIELD AFTER JULY 20, 1893.

NAME.	Date of last picking.	Ounces yielded after July 20.	Total yield in ounces, 1893.	Rank as to yield, 1893.
Mills No. 15	August 1	104	416	2
Mills No. 1	August 1	88	207	5
Ada.............	July 31	50	101	11
Ohio	July 31	48	180	6

Ada ripened a larger per cent of its crop as late fruit than did any other variety, but the amount was comparatively small and the total yield for the season was unsatisfactory. Mills No. 15, gave an excellent late yield. It has not been so hardy here as Shaffer. Mills No. 1 also gave a good late yield. It has been injured but slightly by the winter and has been hardier than Mills No. 15, but it is less productive and its fruit is not so desirable for dessert use. The Ohio is a standard late berry much used for drying.

LIST OF BLACK RASPBERRIES SET IN THE SPRING OF 1893.

Eureka, from W. N. Scarff, New Carlisle, O.
Haynes' Seedling, from I. H. Haynes, Delphi, Ind.
Kansas, from A. H. Griesa, Lawrence, Kan.
Manwaring No. 1, from C. H. Manwaring, Lawrence, Kan.
Mohler, from D. M. Mohler & Co., New Paris, O.

PURPLE RASPBERRIES.

Addison. (*From L. M. Macomber, North Ferrisburg, Vt.,* 1890.) Fruit medium or above, firm, juicy, very good quality and with the flavor of the red raspberry. The new canes are purplish red approaching in color some of the red raspberries; the habit of growth very much resembles the black raspberry and the plants are propagated by tips as are black raspberries. Canes vigorous, hardy and moderately productive.

Babcock's Seedling. (*From Daniel W. Babcock, Dansville, N. Y.,* 1892.) Plants productive, vigorous, with canes of a peculiar purplish color and thickly beset with weak prickles. Fruit crumbles badly. Since this is its first crop at the station the plants are too young to determine its rank as to productiveness.

Cardinal. (*From A. H. Griesa, Lawrence, Kan.,* 1891.) Fruit large, soft, juicy, not so dark colored as Shaffer and better flavored than that variety. In flavor it resembles somewhat the red raspberries. On our grounds it seems to be hardier than Shaffer. Its canes showed no injury from the winter in 1893.

Columbian. (*From Jos. T. Thompson, Oneida, N. Y.*, 1891.) The most productive of all the raspberries fruited on the station grounds this year. Fruit large to very large, moderately juicy, moderately firm, nearly sweet, somewhat darker in color than Shaffer but sweeter and better flavored. So far as tested here its growth has been rather more vigorous and also somewhat more subject to injury by winter than has the Shaffer. It begins to ripen a little later than Shaffer and likewise continues to ripen fruit after the fruiting season of Shaffer has closed. It was still ripening fruit Aug. 7 when the bushes were dug out to prepare a site for a new building. It gave the larger part of its yield between July 18 and August 2, while Shaffer gave the greater part of its yield between July 16 and July 28.

Muskingum. (*From F. R. Palmer & Son, Mansfield, O.* 1889.) Fruit medium to large, soft, moderately juicy, somewhat acid in flavor, good quality. Canes vigorous, injured a little by the winter. On the whole, so far as tested here, it is not so desirable as some other purple varieties.

Shaffer, *Shaffer's Colossal.* A standard purple berry, much esteemed for canning. Fruit large, juicy, moderately firm, fair flavor, pleasant subacid. Plants vigorous and productive.

Smith's Purple. (*From B. F. Smith, Lawrence, Kan.*, 1891.) Except that its fruit is purple this variety has all the characteristics of a black raspberry. Fruit medium size, good quality, with black raspberry flavor. Its productiveness can not be given this season.

All the varieties described above are propagated by tips. Two of them, as noted below, are remarkable for their divergence from the normal type in flavor. Addison, having the habit of growth of the black raspberry, has purple fruit with the flavor of the wild red raspberry, *Rubus strigosus.* Smith's Purple in the character of its canes and foliage, as well as in the flavor of its fruit, is like the black raspberry. Its fruit is reddish purple in color.

The following table shows the comparative yield of the purple raspberries which were in full bearing at this station in 1893.

TABLE VI.— TABLE SHOWING RELATIVE PRODUCTIVENESS AND EARLY AND LATE YIELD OF PURPLE RASPBERRIES IN 1893.

Rank as to yield, 1893.	NAME.	When set.	Per cent of crop picked prior to July 10.	Per cent of crop picked prior to July 20.	Yield of five hills.
					Ounces.
5	Addison	1890	8	33	143
.....	*Babcock's Seedling*	1892	....	....	.....
3	Cardinal	1891	0	60	418
1	Columbian	1891	0	*69	*534
4	Muskingum	1889	0	65	146
.....	*Smith's Purple*	1889	....	....	.....
2	Shaffer	1891	0	47	521

Compared with the early black raspberries none of the purple varieties named above may be called early, but five of them may be called late. Ranked according to the amount of their crop ripened after July twentieth these five varieties stand:

TABLE VII.— LATE PURPLE RASPBERRIES RANKED ACCORDING TO YIELD AFTER JULY 20, 1893.

NAME.	Date of last picking.	Ounces yielded after July 20.	Total yield in ounces, 1893.	Rank as to yield, 1893.
Columbian	Aug. 7	†371	†534	1
Cardinal	Aug. 1	252	418	3
Shaffer	Aug. 3	245	521	2
Muskingum	Aug. 8	96	146	4
Addison	July 31	48	143	5

On consulting table V it is seen that the highest yield of any of the black raspberries after July 20 was one hundred and four ounces. Three purple berries exceed this and one of them alone, the Columbian, gave more than three times this yield of late fruit. Like the red berries the purple berries, as a class, ripen a considerable amount of their crop after the black raspberries, as class, have done fruiting for the season. In order that the late yield of the purple berries may be compared with that of the red raspberries as shown in table IX they are ranked in the following table according to their yield after July 24:

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*Before the fruiting season of Columbian closed the plants had to be dug out to prepare a site for a new building. The total yield and per cent of late yield would therefore be somewhat greater than that given above.

† See note, Table VI.

TABLE VIII. — LATE PURPLE RASPBERRIES RANKED ACCORDING TO YIELD AFTER JULY 20, 1893.

NAME.	Per cent yielded after July 24.	Ounces yielded after July 24.
Columbian	41	*220
Cardinal	29	122
Shaffer	19	100
Muskingum	35	52
Addison	14	21

The purple berries in more than one instance fall below red varieties in the per cent of the crop ripened late in the season, yet, on account of greater productiveness, Columbian and Cardinal give a larger yield of late fruit than does any of the red berries and Shaffer is exceeded in this particular by but one of the red berries.

RED RASPBERRIES.

Rubus Strigosus, Mx. "Wild red raspberry.— Thickets and hills, Labrador to New Jersey and South in the mountains to North Carolina, West to Minnesota and Missouri." Gray.

Rubus Idæus, L. "Cultivated from Europe for the fruit, beset with straight, slender prickles or many of them mere bristles ; leaves thicker and fruit firmer than in *Strigosus ;* fruit red or yellowish." Gray.

Clarke. A well known old variety and one of the most productive tested at this station. It is not a favorite with market growers. It is one of the *Idæus* type having upright, tall, prickly canes and thick, wrinkled leaves. It spreads readily and widely by suckers. Fruit medium to large, turning dark red when fully ripe, juicy, moderately firm, very good in flavor and quality.

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* See note, Table VI.

Cline. (*From G. W. Cline, Winona, Ont.*) Received here in spring of 1893. We have not yet seen its fruit. A chance seedling said to be very early.

Coleman's No. 1. (*From M. H. Coleman, Geneva, N. Y.*, 1889.) Growth moderately vigorous. Fruit large, moderately firm, juicy, nearly sweet, very good in flavor and quality. Moderately productive.

Crimson Beauty. Introduced several years ago. Fruit small to medium, soft, good. Plants unproductive. Canes tall, upright, somewhat bristly, of the *Strigosus* type.

Cuthbert. Holds first rank thus far against all new comers as a market berry. Can see no difference between this and Quinby's Favorite* except that at this station the latter was more productive this year than the former; this holds true not only in comparing Cuthbert set in 1888 with Quinby set in 1890, but also in comparing the two varieties both set the same year on different portions of the same garden plat. Last year Cuthbert took fourth rank as to productiveness among the reds, while the Quinby ranked seventh. The latter, however, had been set but two years and had hardly come into full bearing, while the Cuthbert had been planted four years and was in full bearing. Should the Quinby prove to be an improved strain of Cuthbert it would possibly be worth propagating as such. Further testing will be necessary to decide this point.

Early Pride, *Thompson's Early Pride.* (*From Cleveland Nursery Co., East Rockport, O.*, 1888.) Canes upright, vigorous, of *Strigosus* type. This season it ripened sixteen per cent of its crop prior to July 13, being exceeded in this respect by but three varieties on the list. Fruit medium size, firm, moderately juicy, good in flavor and quality. Canes upright, bristly, vigorous and hardy. This season it was unproductive, ranking twenty-third as to yield; it ranked fifth in 1891† and was called productive in 1889.‡

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*See also E. Williams, Vol. IV, Garden and Forest, p. 592.

†C. E. Hunn in report of this station for 1891.

‡C. E. Hunn in report of this station for 1889.

Early Prolific, *Thompson's Early Prolific.* (*From Cleveland Nursery Co., of East Rockport, O.*, 1888.) Canes of *Strigosus* type, somewhat slender, nearly free from prickles, bright dark red, upright, vigorous. It was not early this season for it gave but five per cent of its crop before July 13, while other varieties had at that time yielded from thirteen per cent to forty-seven per cent of their crop. It gave twenty-nine per cent of its yield after July 24 and is therefore classed with the late berries for 1893. In productiveness it ranked nineteenth. Canes were injured by the winter as much as those of Shaffer.

Fruit paler red than that of Early Pride, more juicy, medium size, firm, good quality.

Erie, *Gladstone*, *Carpenter's No.* 2. Canes vigorous, moderately productive. Sometimes it has borne fruit in the fall, thus making good its claim to a place in the "everbearing" class. Its canes were injured somewhat by the winter 1892–3. Its record at this station has been as follows: 1887 ‡ productive, in 1888 ‡ unproductive, in 1889 † productive, in 1890 † very productive. On the whole it has not compared favorably here with the best of the older varieties.

Fruit medium or above, rather soft, moderately juicy, good quality, nearly sweet, crimson or purplish red when very ripe. It ranks fifteenth in productiveness for 1893.

Genesee. (*From Z. H. Harris, Rochester, N. Y.*, 1888.) Fruit large, scarlet, soft, good quality. Canes of *Idæus* type, moderately vigorous, tender. Ninety per cent of the canes killed to the ground last winter with a minimum temperature of six degrees below zero.

Gladstone. See ERIE. Originated by Charles Carpenter, Kelley Island, Ohio, and first disseminated under the name of Erie.

Hansell. Fruit medium size, bright red, firm, moderately juicy, good quality, not very productive here. But four per cent of its crop was picked prior to July 13 while at that time

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‡ M. H. Beckwith in reports of this station 1887 and 1888.

† C. C. Hunn in reports of this station 1889 and 1890.

Rancocas had yielded forty-seven per cent of its crop and several other sorts had yielded a considerable portion of their crop. See table IX, p. 651.

Harris. (*From Z. H. Harris, Rochester, N. Y.*, 1889.) Vigorous but dwarf canes of *strigosus* type. Fruit medium to large, moderately pulpy and juicy, firm, fine flavor, very good quality, nearly sweet. So far as tested here its fruit keeps better after being picked than does Cuthbert. Further testing will be necessary to compare it with other standard sorts as to productiveness and season of ripening.

Lost Rubies. An old variety now generally discarded. On the station grounds it has been neither hardy nor productive. Its blossoms appear to be practically incapable of fertilizing themselves. Turner and Brandywine are said to fertilize Lost Rubies so that it will produce satisfactory crops. We have not tested this claim.

Meredith Queen. Introduced about ten years ago by E. J. Brownell, Franklin, N. Y., from whom we received it. Canes sucker freely, and are vigorous but not hardy. Fruit medium size, reddish salmon color, juicy, moderately firm, good. Season late; plants not very productive.

Miller's Woodland. Suckers freely. Canes moderately vigorous, hardy, *strigosus* type. Fruit bright crimson, medium size, not juicy, firm, good quality; midseason to late. It does not rank high either in productiveness or as a late berry.

Montclair. A chance seedling on the grounds of E. and J. C. Williams, Montclair, N. J. Fruit medium to large, juicy, moderately firm, mild subacid, pleasant flavor, good quality. Plants moderately productive this season. So far as tested here it has proved inferior to standard varieties.

Naomi. Originated in the garden of Gov. Wood, Cleveland, O., and introduced by Chas. Carpenter, Kelley Island, O., from whom the station received it in 18‑6. The plants have several times been quite seriously injured by the winter. The canes and foliage show indications of *Idæus* blood. Growth vigorous. Fruit large, soft, mild subacid but nearly sweet when very ripe, juicy, pleasant flavor, good quality. Ranks tenth in yield for 1893.

Olathe. *Stayman's No.* 5. (*From Stayman and Black, Leavenworth, Kan.*, 1888.) Canes rather slender, vigorous, upright, dark red color, *strigosus* type. Fruit large, firm, juicy, good quality, good color. In productiveness for 1893 it ranks about with Clarke which stands fifth on the list. As a late berry it stands third on the list for 1893, being surpassed in this feature only by Cuthbert and Royal Church. The first good picking was made July 17 and the last July 31. Its fruiting season was from July 15 to August 8, 1893. * The plants were set in 1888, bore a heavy crop in '90, ranked sixth in productiveness among the reds in '91 and first in '92. It may prove valuable in some sections and we recommend it for trial.

Parry's No. 1. (*From Wm. Parry, Parry, N. J.*, 1888.) Canes strong, nearly upright, vigorous, *strigosus* type. Fruit medium to large, firm, moderately juicy, mild subacid, good quality. It ranks sixth as to productiveness in 1893 and fourth as to the yield of late fruit. Its fruiting season was from July 13 to August 12, but the heaviest pickings were from July 17 to August 3. The originator has discarded this variety because it has not proved superior to other varieties already introduced.

Parry's No. 2. (*From Wm. Parry, Parry, N. J.*, 1888.) *Strigosus* type, vigorous, upright. Fruit large, firm, moderately juicy, mild subacid, very good in flavor and quality. It ranks ninth as to productiveness for 1893 and eighth in the yield of late fruit. Season, midseason to late. It has not proved superior to varieties already in cultivation and the originator has therefore discarded it.

Philadelphia. A well known old variety bearing dark crimson fruit, midseason, medium size, rather soft and disposed to crumble. It is now generally superseded by more desirable sorts. It ranked eighth in productiveness for 1893.

Pomona. (*From Wm. Parry, N. J.*, 1888.) Canes moderately vigorous, upright, of *strigosus* type with a suggestion of *Idæus* blood in the foliage. Fruit large, fine scarlet color, moderately firm, juicy, nearly sweet, very good in quality and flavor. In yield for 1893 it ranked about with Royal Church which stands second on the list. It has made an excellent record here, and is considered one of the most desirable home raspberries on the grounds. Thirteen per cent of its crop was picked before July 13, and seventeen per cent after July 24, thus showing that it has a long fruiting season. Mr. Parry has discarded this variety because he has not found it valuable. If it will do as well in other localities as it has done here we believe it is worthy of introduction as a home and local market variety.

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* C. E. Hunn, reports of this station for 1890, '91 and '92.

Pride of Kent. (*From R. S. Edwards, Highland, Col*, 1892.) Canes strong, vigorous, of *Iœdus* type. Was not injured last winter though the thermometer fell to six degrees below zero. Fruit large to very large, very soft, delicious flavor, very good in quality. Its rank as to productiveness is not given since this is its first crop at the station.

Quinby, Quinby's Favorite. See **Cuthbert.**

Rancocas. A chance seedling from the grounds of A. Hansell, Burlington county, N. J. An early variety but unproductive here. Although it ripened nearly one-half its fruit before July 13, it ranked third as to the amount of early fruit produced. See table IX, page 651. Fruit small to medium, fair flavor, juicy, soft.

Reder. Canes moderately vigorous. Fruit medium size, good scarlet color, juicy, moderately firm, very good quality, midseason to late. Ranks twelfth as to productiveness for 1893.

Reliance. Originated by O. L. Felton, Merchantville, N. J., and introduced about fifteen years ago. Canes vigorous, of *strigosus* type. Fruit crumbles slightly, small to medium in size, crimson color, soft, juicy, sweet, very good quality, midseason, not very productive here. Ranks about with Early Prolific as to yield.

Royal Church. (*A chance seedling from Royal Church Harrisonville, O.*, 1891.) Notwithstanding the fact that the canes were injured somewhat by the previous winter it ranks second as to productiveness for 1893. Grains large, pulpy; fruit large, moderately juicy; very good in flavor and in quality; somewhat disposed to crumble. First ripe fruit July 11, first good picking

July 17, last good picking Aug. 3, last picking Aug. 12. We consider it worthy of trial for the home garden at least.

Canes vigorous, of *strigosus* type with a suggestion of some other species in the prickly curving canes tinged with reddish purple and in the purple tinge of the foliage. In its late fruiting season it resembles the purple berries. In the wrinkled leaves Mr. Hunn sees a resemblance to *R. Idæus*. See Annual Report this station 1892, p. 690.

Superb. Originated with J. Churchman, Burlington, N. J., about twenty years ago. It does not take very high rank among the raspberries tested here. It ranks fourteenth in productiveness for 1893 and fourteenth also in the amount of late fruit.

Thwack. Small to medium, midseason, firm, moderately juicy, sweet; not very productive here.

Turner. An old variety, productive and hardy. Fruit medium size, bright red color, juicy, sweet, very good in flavor and in quality It gave its best pickings from July 10 to July 23. Although not equal to Cuthbert as a market berry, yet on account of its hardiness and productiveness it is valued in many localities where Cuthbert does not succeed. Fruiting season earlier than that of Cuthbert. Canes of medium height, vigorous, upright, and nearly free from bristles, *strigosus* type. Suckers freely.

YIELD OF RED RASPBERRIES.

The following table shows the yield of red raspberries fruited at this station in 1893; the per cent of the crop picked before July 13; the per cent picked after July 24, and with those kinds which were grown in hills, the total yield of five hills for the season. Some varieties have not been confined to hills during the last year and plants have partly filled the row. The yield of these varieties is therefore not strictly comparable with the yield of the varieties kept in hills. Names of such varieties are marked with a star in the following list and their rank as nearly as can be determined is given in the note following the table.

TABLE IX.—SHOWING RELATIVE PRODUCTIVENESS, AND EARLY AND LATE YIELD OF RED RASPBERRIES IN 1893.

Rank as to yield, 1893.	NAME.	When set.	Per cent of crop picked prior to July 24.	Per cent of crop picked after July 24.	Yield of five hills, 1893. Ounces.
25	Brandywine	1888	0	57	50
5	Clarke	1888	10	20	206
17	Coleman's No. 1	1889	21	19	104
24	Crimson Beauty	1888	10	10	55
11	Cuthbert	1888	0	37	150
1	Cuthbert, *Quinby's Favorite*	1890	0	30	320
23	Early Pride	1888	16	5	63
19	Early Prolific	1888	5	29	80
15	Erie, *Gladstone*	1888	9	26	115
*	Genesee	1888	3	62	....
26	Hansell	1888	4	40	42
*	Harris	1889	5	19	*207
27	Lost Rubies	1888	0	16	13
*	Meredith Queen	1888	0	69	*82
13	Miller's Woodland	1888	5	38	131
*	Montclair	1888	19	17	*96
10	Naomi	1888	6	36	152
*	Olathe	1888	0	35	*229
6	Parry's No. 1	1888	0	40	200
9	Parry's No. 2	1888	0	33	155
8	Philadelphia	1888	0	9	180
*	Pomona	1888	13	17	*299
*	Pride of Kent	1892	15	6	....
....	*Quinby's Favorite.* See Cuthbert	....	......	......	....
19	Rancocas	1888	47	0	80
12	Reder	1888	11	28	144
*	Reliance	1888	12	5	*74
2	Royal Church	1891	0	39	294
14	Superb	1888	3	28	120
....	*Thompson's Early Pride.* See Early Pride	....	......	......	....
....	*Thompson's Early Prolific.* See Early Prolific	....	......	......	....
*	Thwack	1888	0	44	*102
8	Turner	1888	7	9	180

*Plants were allowed to partially fill the row and therefore are not strictly comparable with plants on equal area grown in hills. As nearly as can be estimated the rank of Pomona was about with Royal Church; Olathe about with Clarke; Montclair and Reliance about with Early Prolific; Thwack about with Coleman's No. 1, and Meredith Queen about with Early Pride.

EARLY RED RASPBERRIES.

In 1893 the greater part of the red raspberry crop at this station ripened within the twelve days from July 13 to July 24, inclusive. Any kinds which ripened a considerable portion of their crop prior to July 13 may be called early for this year, and any kinds which ripened a considerable portion of their crop after July 24 may be called late for this year.

With this standard in view an examination of table IX shows that six of the twenty-nine varieties on the list yielded over twelve per cent of their crop before July 13. Arranged in order according to the amount yielded before July 13, they stand:

TABLE X.— EARLY RED RASPBERRIES RANKED ACCORDING TO YIELD PRIOR TO JULY 13, 1893.

Name.	Date of first Picking	Yield before July 13.	Total yield.	Rank as to total yield 1893.
		Ounces.	Ounces.	
Pomona	July 10	38	*299*	†
Coleman's No 1	July 6	22	104	17
Rancocas	July 6	22	47	19
Montclair	July 6	14	76	‡
Early Pride	July 6	10	63	23
Pride of Kent,*	July 8	9	64	*

Of Pride of Kent nothing can be said here except that this crop was from plants set last season. Rancocas, Early Pride and Montclair are too unproductive here for pay for growing even for early fruit. Coleman's No. 1 is moderately productive and gave one-fifth of its crop early in the season. All things considered, Pomona was the most satisfactory early red raspberry tested this season. It is mentioned again under the late berries, page 653.

LATE RED RASPBERRIES.

Referring again to table IX for a list of late varieties eighteen kinds are found that gave one-fifth, or more, of their yield after July 24. Of these Brandywine, Early Prolific, Erie and Hansell need not be considered further in this connection on account of their unproductiveness. The names of the other fourteen varieties appear in the following list of late varieties which yielded thirty ounces, or more, after July 24.

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*First crop. Set 1892.

†About with Royal Church. See note, Table IX.

‡See note, Table IX.

TABLE XI.—LATE RED RASPBERRIES RANKED ACCORDING TO YIELD AFTER JULY 24.

NAME.	Date of last picking.	Yield after July 24.	Total yield.	Rank as to total yield, 1893.
		Ounces.	Ounces.	
Royal Church	Aug. 12	116	294	2
Cuthbert (*Quinby's Favorite*)	Aug. 12	97	320	1
Olathe	Aug. 8	80*	229*	*
Parry's No. 1	Aug. 12	79	200	6
Genesee	Aug. 12	64*†	*	*†
Meredith Queen	Aug. 8	57*	82*	*
Naomi	Aug. 8	54	152	10
Parry's No. 2	Aug. 12	52	155	9
Pomona	Aug. 8	51*	299*	*
Miller's Woodland	Aug. 8	50	131	13
Thwack	Aug. 12	45*	102*	*
Cuthbert	Aug. 8	44	150	11
Clarke	Aug. 12	42	206	5
Superb	Aug. 8	33	120	14
Reder	Aug. 3	32	144	12

Pomona, p.648 is listed both with the early and with the late varieties; its fruiting season is long, making it, on that account, desirable for home use. Its "good pickings" came between July 10 and August 1.

Royal Church, p. 649 gave its "good pickings" between July 17 and August 8. So far as tested here, this for late and Pomona for early fruit may be recommended as an excellent combination for the home garden.

Cuthbert, p. 645 gave its "good pickings" between July 17 and August 1, having a shorter season than either Pomona or Royal Church.

The three varities just named are not only productive but yield fruit of good size, fine color and good flavor.

Olathe, p. 648 is worthy of a trial as a late berry. It ranks high in productiveness, and in the firmness, quality and color of its fruit. Season about the same as that of Cuthbert.

YELLOW RASPBERRIES.

The yellow or "white" raspberries usually do not sell well in market and they are of value chiefly for the amateur or home garden. Some of the most delicious raspberries in cultivation belong to this group but their delicacy of color and of texture unfit them for even the local market. Others of the group are of little value for any use.

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* See note table IX. † Killed to the ground last winter.

The white or yellow raspberries belong chiefly either to the *Idæus* or to the *Occidentalis* species. The pale fruit is commonly correlated with corresponding pale canes and sometimes also with foliage paler than that of the normal type.

American White. *Yellow Cap. Golden Cap.* (*From M. F. Pierson, Seneca Castle, N. Y.*, 1890.) An old variety of the black raspberry (*Occidentalis*) species. Fruit small to medium, dark orange color, rich acid, black cap flavor, moderately juicy, firm, good quality. Plants vigorous and hardy but not productive here.

Caroline. Originated several years ago by S. P. Carpenter, New Rochelle, N. Y. It is supposed to be a seedling of the Orange crossed by a golden cap. It shows *Idæus* characters and may be propagated either by suckers or by tips. Canes pale, nearly free from bristles or prickles, curving, vigorous.

Fruit medium size, orange pink color deepened to a salmon tinge when fully ripe. Flesh soft, juicy, with delicate acid flavor and of very good quality. Its fruiting season lasts about a month. Of all the varieties of either the *Idæus* or of the *strigosus* type which have been tested here it is one of the most productive.

Champlain. (*From J. T. Macomber, Grand Isle, Vt.*, 1888.) A seedling of White Antwerp originated by J. T. Macomber. Canes vigorous, pale color, *Idæus* type. Fruit medium to large, pale yellow, soft, juicy, nearly sweet, excellent flavor, best quality. Not so productive as Caroline here but its fruit is superior to that of Caroline.

Crystal White. (*From A. J. Caywood & Son, Marlboro, N. Y.*, 1888.) Canes moderately vigorous, pale color, rather tender here, *Idæus* type, moderately productive. Fruit medium or above, clear pale yellow, moderately firm, moderately juicy, good quality and good flavor.

Golden Queen. Supposed to be a seedling of Cuthbert. Fruit fine yellow color, medium to large, Cuthbert shape, soft, moderately juicy, sweet and very good in flavor and quality. Canes pale color, somewhat prickly, suggestive of *Idæus* blood, vigorous and, so far as tested here, as hardy as Shaffer.

Golden Thornless. (*From M. F. Pierson, Seneca Castle, N. Y.*, 1890.) An old variety. Fruit medium size, moderately firm but crumbles, juicy, good quality, with black raspberry flavor; color orange, turning darker when fully ripe. Canes whitish, vigorous, with slender branches and nearly free from prickles.

Orange. *Brinckle's Orange.* An old variety that many consider the standard of excellence for quality among cultivated raspberries. It is unfortunately rather tender and in most parts of this State needs winter protection. Fruit large, very soft, juicy, best in flavor and quality, beautiful orange pink when fully ripe. Canes moderately vigorous, *Idæus* type.

Silver Queen. First plants set 1885; reset 1888. Rather tender here. Fruit clear pale yellow, medium to large, very soft, juicy, nearly sweet, delicate flavor; very good to best.

Vermont. (*From L. M. Macomber, North Ferrisburg, Vt.*, 1890.) Canes and foliage show *Idæus* parentage, prickles numerous. A delicious amateur fruit of beautiful pale yellow dusted with white down, large size, very soft, pulpy, juicy, best quality, productive.

YIELD OF YELLOW RASPBERRIES.

The following table shows the yield of the yellow raspberries fruited at this station in 1893:

TABLE XII.—YIELD OF YELLOW RASPBERRIES, 1893.

Rank as to yield, 1893.	NAME.	Yield of five hills. Ounces.	Date of first picking.	Date of last picking.
8	American White	47	July 10	July 21
2	Caroline	190	July 6	Aug. 8
3	Champlain	152	July 6	Aug. 3
7	Crystal White	126	July 10	Aug. 3
6	Golden Queen	132	July 15	Aug. 8
9	Golden Thornless	32	July 10	July 21
5	Orange (*Brinckle's*)	134	July 6	Aug. 8
4	Silver Queen	151	July 10	Aug. 8
1	Vermont	196	July 6	Aug. 4

Of the above list Caroline is one of the most productive at this station. Vermont is also prolific of delicious fruits. Champlain, though not so productive as Caroline here, is a better fruit than Caroline both in flavor and in quality.

SOME EXPERIENCES IN TESTING STRAWBERRIES.

For several years this station has conducted tests with different varieties of strawberries in order that the numerous inquiries which it receives concerning both old and new sorts might be answered more intelligently than would otherwise be possible, and also that the general demand for information concerning the comparative merits of the newer varieties might be met by publishing annually in the station's bulletins or annual reports the record of these varieties as grown at this station.*

No one understands better than the average strawberry grower that no variety, however meritorious it may be, does equally well in all locations and on all soils. It is therefore hardly necessary to remind those readers for whose benefit this bulletin is prepared that it is not the purpose of the station reports issued from time to time to pass final judgment as to the merits of the varieties discussed, but rather to offer a contribution to our knowledge of these varieties by setting forth the merits or demerits developed by the plants grown on our soil and under the climatic conditions found here.

During the years in which the work of testing strawberry varieties has been prosecuted here, the station has endeavored to obtain the newer kinds for testing as fast as they were introduced to public notice. Many originators of new varieties, realizing the importance of the impartial tests conducted by this station, have sent plants of new varieties to the station for testing two or three years before they were placed on the market.

The strawberries tested here are grown on a fertile clay loam, well tile drained and sloping gently towards the south. Some varieties seem well adapted to this location and have given excellent results; other kinds have not succeeded as well here as they have done in other localities. The notes presented in the following pages are based simply on the record of the various varieties as grown on the station grounds.

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*See annual report of this station for 1883, p. 226; 1885, pp. 226–227; 1886, pp. 253–254; 1887, pp. 333–335; 1888, pp. 229–231; 1889, pp. 298–306; 1890, pp. 258–274; 1891, pp. 460–468, and 1892, pp. 681–689. The report on strawberries found in the annual report of this station for 1890 was also published in its bulletin 24; that for 1891 was also published in bulletin 36; that for 1892 was also published in bulletin 44 and a portion of the report for 1893 was published in bulletin 64.

Nearly one hundred and thirty named varieties of strawberries were fruited at this station in 1893, and also nearly four hundred and thirty station seedlings. About thirty new varieties received for testing during the spring of 1893, are expected to fruit here for the first time in 1894. Many new station seedlings will also fruit for the first time in 1894.

NOTES ON VARIETIES.

The varieties which fruited at the station for the first time in 1893 are described below. The blooming season of pistillate plants in each case is compared with the blooming season of some well known staminate variety which may be used for fertilizing their blossoms. When the productiveness of a variety is not mentioned its yield may be compared with that of other kinds by consulting table XIII, p. 673, which gives the rank of the thirty berries most productive here in 1893; should its name not appear in that table it may then be inferred that its yield was hardly satisfactory here in 1893.

NOTE.—In the following descriptions the quality of the fruit is designated as poor, fair, good, very good or best, as the case may be. The expression "good stems" is used to designate stems of average length and strength; short, long or prostrate stems are specially mentioned. Synonyms and unnamed seedlings are given in italics. The staminate varieties (having perfect flowers) are marked "S" and the pistillate varieties (having imperfect flowers) are marked "P."

Accomack, S. (*From A. J. McMath, Onley, Va., and Slaymaker & Son, Dover, Del.*) Plants vigorous; foliage good: runners few, consequently unproductive in matted row. Fruit medium to large, borne on good stems, soft, good in flavor and quality. Fruiting season rather late and short.

Advancer, S. (*From R. S. Cole, Harmons, Md.*) Season early and short. Fruit medium size, borne on good stems, dark color, firm, very good in quality. Foliage good. Runners moderately abundant, consequently the yield is low for matted rows.

Alabama, S. (*From Prof. E. S. Goff, Madison, Wis.*) Foliage perfect; runners abundant; stems good. Fruit midseason, medium size, fair quality, good flavor, firm. Not enough plants were obtained to secure reliable data as to yield.

Allen's No. 1, P. (*From W. S. Allen, Salisbury, Md.*) Blossoms with Manchester. Foliage burned in the very hot, dry weather at the beginning of the fruiting season. Runners moderately abundant; stems good; fruit medium to large, of fair quality, firm. Season medium early, and lasted about ten days.

Allen's No. 3, S. (*From W. F. Allen, Salisbury, Md.*) Foliage burned as with Allen's No. 1. Forms runners in great abundance; stems good; fruit medium to large, dark crimson, moderately firm, good quality; productive.

Anna Forest, S. (*From D. Brandt, Bremen, O.*) This variety was introduced several years ago. On our soil it forms runners very slowly and consequently is unproductive in matted row. Fruit midseason, medium to large, fair quality, firm. Fruiting season lasts about a week.

Arkansaw Traveler, P. (*From T. G. Michel, Judsonia, Ark.*) Blossoms with Manchester. Foliage first class; runners very abundant; fruit midseason, moderately firm, medium to large, borne on long prostrate stems; quality fair to good. Fruiting season about ten days long. Moderately productive on our soil.

Belle, S. (*From Cleveland Nursery Co., Rio Vista, Va.*) Foliage good; runners moderately abundant; stem good; fruit late, firm, medium to very large in size, holds its size well till late in the season, not uniform in shape, often elongated wedge shape, sometimes with large core and unripe tip; quality good. Needs to be tested further before deciding as to its merits on our soil.

Beverly, S. (*From Benj. W. Smith, Beverly, Mass.*) Commenced ripening its fruit early and fruiting season lasted about eighteen days Plants had good foliage, were moderately productive and formed new plants in matted row rather slowly. Fruit medium size, good and firm.

Cameronian, S. (*From L. J. Farmer, Pulaski, N. Y.*) Moderately vigorous; does not form runners abundantly; stem short. Fruit midseason, medium to large, good quality, firm.

Chair's Favorite, S. Fruiting season lasted from June 19 to July 7. Foliage good; runners formed abundantly; stems good; plants not so productive as Haverland but nearly equal to Middlefield. Fruit medium to large, soft, good quality.

Cheyenne, P. (*From Stayman & Black, Leavenworth, Kans.*) Blossoms with Sharpless. Has not done well on our soil. Season late; foliage good; stems short; few runners. Fruit has a prominent neck and is not uniform in shape, medium to large, very good in quality, firm.

Clark's Early, *Early Idaho*, S. (*From Slaymaker & Son, Dover, Del., and D. Brandt, Bremen, Ohio.*) Foliage good; runners moderately abundant; stem short. Fruit midseason, medium or above, symmetrical and uniform, dark color, firm, very good quality. As grown here it ranked with Crescent in productiveness but fell below Sharpless or Jucunda.

Clyde, *Cycloma*, S. (*From Stayman & Black, Leavenworth, Kans.*) Season late; fruit medium to large, good quality, moderately firm. Foliage good, runners few on our soil. Productiveness can not be given this season.

Crosby's No. 10. (*From Phineas Crosby, Clinton, Wis.*) Foliage good; runners abundant; stems long. Fruiting season lasted three weeks. Fruit midseason to late, medium size, good quality, firm. Berry has a tendency to ripen unevenly. More productive than Sharpless as grown here.

Crosby, *Crosby's No.* 27, S. (*From Phineas Crosby, Clinton, Wis.*) Season same as Crosby's No. 10; plants more productive, runners equally abundant and foliage somewhat better than with that variety. Fruit medium size, good quality, firm.

Crosby's No. 91, S. Season about the same as Crosby's No. 10, runners equally abundant and foliage as good as Crosby. In yield it ranks between Crosby's No. 10 and Crosby. Stems good. Fruit medium to large, good quality, firm.

Cycloma, See **Clyde**.

Curtis No. 15, P. (*From B. O. Curtis, Paris, Ills.*, 1892.) Stems not very long, runners abundant, foliage good. Fruit medium to large, good quality, firm. Slightly more productive than Crescent here.

Curtis No. 154, S. (*From B. O. Curtis, Paris, Ills.*, 1892.) Stems long; foliage slightly burned in the hot, dry weather at the beginning of the fruiting season; runners abundant. Fruit medium to large, good quality, firm. More productive than Crescent but less productive than Sharpless here.

Custer, S. (*From S. F. Hull, Cherry Valley, Ills.*, 1892.) Stems not very long, runners not abundant, foliage good. Fruit medium size, regular, good quality, firm. Slightly more productive than Crescent.

Dayton Early, S. (*From Sam'l Kinsey & Co., Kinsey, Ohio.*) Medium early; fruiting season lasted about two weeks. Fruit symmetrical, of good scarlet color, medium to large, moderately firm, very good in quality with slight Alpine flavor. Stem short; foliage good; runners but moderately abundant and hence the variety is not very productive on our soil.

D and D, S. (*From Prof. E. S. Goff, Madison, Wis.*) Midseason; medium to large; fair quality; firm. Foliage burned quite badly in the very hot, dry weather at the opening of the fruiting season. Runners but moderately abundant on our soil and hence the variety is unproductive in matted row.

Dew, S. (*From D. Brandt, Bremen, Ohio.*) Midseason to late; fruiting season lasted nearly three weeks. Foliage first class; fruit large, often irregular in form, of fair quality and soft. Runners moderately abundant much the same as with Sharpless, but the yield is somewhat better than with that variety on our soil.

Early Idaho, see **Clark's Early**.

Edwards' Favorite, S. (*From R. S. Edwards, Highlands, Colo.*) Midseason to late; foliage fair to good; runners abundant; stems good; fruit medium to large, good scarlet color, soft. Plants moderately productive on our soil, giving better yield than either Sharpless or Manchester. Judging from this its first season of fruiting at this station Edward's Favorite seems to be worthy of extended trial as an amateur fruit of late season. The fruit was in excellent condition at the time of its last picking, July fourteenth. It is not firm enough to ship to distant markets.

Engle's No. 1, S. (*From T. T. Lyon, South Haven, Mich.*) Midseason to late; foliage good; runners not very abundant; stems good; fruit medium to large, good quality, soft. On our soil the yield is somewhat better than with Wilson but not so good as that of Crescent.

Epping, *Yankee Doodle*, P. (*From Geo. Q. Dow, North Epping, N. H.*) Blossoms with Manchester. Fruit midseason, medium size, good quality, soft. Foliage slightly burned in the hot, dry weather at the beginning of the fruiting season; stems good; runners moderately abundant on our soil, not filling two-thirds of the space allotted to the matted row.

E. P. Roe, S. (*From T. J. Dwyer, Cornwall, N. Y.*) Planted in spring of 1892, but has not made runners enough to justify a description of fruit and foliage.

Everbearing, S. (*From Chas. S. Lindley, Emporia, Va.*) Fruit midseason (June 19 to July 5), medium size, symmetrical, uniform shape, good color, good to very good in quality, soft. Stem short; foliage not very vigorous and runners not very abundant. Slightly more productive than Sharpless.

Gandy Belle, S. (*From S. B. Cole, Bridgeton, N. J.*) Midseason; foliage good; runners very abundant; stems long and prostrate; fruit medium to large, good, firm, dark crimson. More productive than Crescent but drops below Sharpless in yield as grown here.

Galerson, S. (*From Ellwanger & Barry, Rochester, N. Y.*) Midseason to late, medium size, symmetrical, poor quality, firm, fine color. Stems and foliage good; runners not very abundant. In productiveness, as grown here, it ranks about with Manchester.

General Putnam, P. (*From G. H. and J. H. Hale, South Glastonbury, Conn.*) Blossoms about with Beder Wood. Midseason, medium to large, light crimson, very soft, good quality, unproductive in matted row. Foliage moderately vigorous, badly burned in the very hot, dry weather at the beginning of the fruiting season. Stems good. Runners not abundant.

Glenfield, S. (*From Stayman & Black, Leavenworth, Kans.*) Planted in the spring of 1892, but has not yet made plants enough to justify a description of the variety.

Hall's Seedling, P. (*From S. E. Hall, Cherry Valley, Ills.*) Blossoms about with Manchester and Sharpless. Foliage very good runners moderately abundant; stems good. Fruit midseason, medium size, fair quality, firm. As grown here it is less productive than Sharpless but more so than Crescent.

Holcomb's Seedling, S. (*From W. C. Holcomb, Mecca, Ohio.*) Foliage moderately vigorous; runners abundant; stems good. Fruit medium to large, good, firm, midseason to late. As grown here it ranks with Manchester in productiveness.

Herbert, S. (*From B. L. Carr, Saratoga Springs, N. Y.*) Midseason, small to medium, fair quality, firm. Foliage good; runners not abundant, filling no more than half the space allotted to the matted row; stem short, plants very unproductive.

Kincks, S. (*From Clark Hewett, Waupun, Wis.*) Midseason to late. Foliage good, stems good, runners not abundant enough to fill half the space allotted to the matted row. Fruit medium to large, good, soft. In productiveness it ranked between Sharpless and Crescent.

Latest of All. (*From Ellwanger & Barry, Rochester, N. Y.*) Set in the spring of 1892, but has not made plants enough to justify a description of the variety.

Laxton's Captain, S. (*From Ellwanger & Barry; Rochester, N. Y.*) Set in spring of 1892, but has not made plants enough to justify a description of the variety.

Magnate, P. (*From Stayman & Black, Leavenworth, Kans.*) Blossoms with Wilson. Fruit midseason, medium to large, elongated and flattened, good, soft. Foliage good, stems good, runners not very abundant. In productiveness it ranks between Sharpless and Crescent.

Meek's Early, *Advance*, S. (*From Slaymaker & Son, Dover, Del.*) Fruit of medium size, borne on good stems. Foliage good, runners few, consequently the matted row is comparatively unproductive. Length of fruiting season about two weeks.

Muskingum, S. (*From S. R. Moore, Zanesville, Ohio.*) Midseason to late, medium size, fair quality. Foliage not very vigorous, runners few, stem good. Falls below Crescent in productiveness.

Oregon verbearing, S. Imperfectly staminate. (*From D. Brandt, Bremen, O.*) Midseason, medium size, poor quality, soft. Foliage fair to good, runners not very abundant, stems good. Slightly more productive than Sharpless. Quite distinct from the Everbearing mentioned above, being superior to it in size but much inferior in quality.

Pawnee, S. (*From Stayman & Black, Leavenworth, Kans.*) Foliage fair to good, slightly burned in the hot, dry weather at the beginning of the fruiting season; stems good. Fruit medium size, very good, soft. Season early to late, lasting over three weeks. In productiveness it ranks between Sharpless and Crescent. Runners fairly abundant.

Princeton Chief, P. (*From F. W. Poscharsky & Son, Princeton, Ill.*) Blossoms about with Manchester. Foliage good; runners abundant; stems long; fruit midseason to late, medium size, moderately firm, good quality and of good color, although rather dark when fully ripe. Among the strawberries fruited at this station for the first time in 1893 the Princeton Chief ranks fifth in productiveness. It was much more productive on our soil than Bubach and will probably ship as well as that variety.

Princess, P. (*From R. Johnston, Shortsville, N. Y.*) Blossoms about with Manchester. Medium early. Fruiting season lasted about two weeks. Foliage fair to good; stems good; runners abundant; fruit medium size, good, soft. About equal to Sharpless in productiveness as grown here.

Primate, S. (*From Stayman & Black, Leavenworth, Kan.*) Midseason, medium to large, good, soft. Foliage good; stems good; runners moderately abundant. In productiveness it ranks between Sharpless and Crescent.

Rio, *Thompson's No.* 9. (*From Cleveland Nursery Co., Rio Vista, Va.*) Seedling of Sharpless. Foliage good; runners abundant; stem good; fruit medium size, good quality, firm, midseason; unproductive on our soil.

Sandoval, S. (*From R. D. McGeehon, Atlantic, Iowa.*) Midseason to late; medium size, symmetrical, dark crimson, good quality, firm. Foliage fair to good, stems good, runners not abundant. Unproductive on our soil.

Smeltzer, *Smeltzer's Early*, S. (*From M. F. H. Smeltzer, Van Buren, Ark.*) Early, long season; medium to large; good quality, moderately firm; fruit stems medium; foliage vigorous, runners abundant. Plants moderately productive.

Smith, P. (*From Coe & Converse, Ft. Atkinson, Wis.*) Blossoms with Manchester. Foliage fair to good, burned somewhat in the hot, dry weather at the beginning of the fruiting season. Runners abundant; stems good; fruit medium size, fair quality, firm. On our soil this variety is not so productive as Middlefield, but exceeds Manchester in yield.

Southard, *Southard's Early*, S. (*From G. H. & J. H. Hale, South Glastonbury, Conn.*) Midseason, medium to large, good quality, soft. In productiveness it ranked between Sharpless and Crescent. Foliage moderately vigorous; runners not very abundant; stems good.

Stayman's No. 3, S. (*From Stayman & Black, Leavenworth, Kan.*) Midseason; medium to large, elongated, quite uniform in size; quality very good; firm; foliage good; runners few; plant unproductive here.

Sunny Side, P. (*From Chas. S. Pratt, Reading, Mass.*) Blossoms about with Sharpless. Season late, lasting about two weeks. Fruit medium to large, fair quality, firm, bright scarlet color. Foliage first class; runners abundant; stem long. In productiveness Sunny Side heads the list of the varieties fruited at the station this season.* The merits of no berry can be properly estimated from one season's trial, and the Sunny Side must be tested further and compared with standard sorts before we can decide definitely as to its merits in this locality. The indications are that it may prove worthy of introduction as a late market berry.

Swindle, P. (*From G. H. and J. H. Hale, South Glastonbury, Conn.*) Blossoms about with Manchester. Midseason to late; foliage burned in the hot dry weather at the beginning of the fruiting season; runners few; stems good. Fruit medium to large, often irregular in shape, fair quality, firm, unproductive on our soil.

Thompson's No. 40. P. (*From Cleveland Nursery Co., Rio Vista, Va.*) Blossoms with Manchester. Midseason, medium size, good, moderately firm. Foliage very good; runners very abundant; stems long. The indications are that it may prove valuable for a home and local market berry. In productiveness it stands third on the list at this station in 1893.

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* Those varieties marked with a * in Table I are not given rank as to yield in 1893.

Townsend's No. 2, S. (*From T. T. Lyon, South Haven, Mich.*) Midseason, medium to large or occasionally vary large, symmetrical, rather dark color, very good quality. Foliage good; strong, upright stems; runners moderately abundant. Ranked with Haverland in productiveness.

Townsend's No. 3, P. (*From T. T. Lyon, South Haven, Mich.*) Blossoms with Manchester. Midseason, medium to large, poor quality. Foliage good, stem short, runners abundant. Slightly more productive than the Sharpless this season.

Townsend's No. 9, P. (*From T. T. Lyon, South Haven, Mich.*) Blossoms with Manchester. Early to late, medium size, moderately firm, good quality. Foliage good; stems medium to long, prostrate; runners very abundant. In productiveness this season it ranked above Middlefield and below Haverland.

Townsend's No. 20, P. (*From Geo. Townsend, Gordon, Ohio, and T. T. Lyon, South Haven, Mich.*) Blossoms about with Sharpless. Fruit midseason to late, medium to large, good color, good shape, good quality, firm. Foliage healthy and vigorous, runners very abundant, stem strong. Not quite so productive this season as Townsend's No. 9.

West Lawn, P. (*From C. B. Bauer, Judsonia, Ark.*) Blossoms with Manchester. Fruit midseason, medium size, good, firm. Foliage good, runners very abundant, stems long. In productiveness it ranked about with Manchester.

Wilton, S. (*From B. L. Carr, Saratoga Springs, N. Y.*) Midseason, small to medium, quite uniform in size, good quality, firm. Foliage not very vigorous; runners moderately abundant; stem short. Unproductive on our soil.

Yankee Doodle, see Epping.

VARIETIES FRUITED AT THIS STATION PRIOR TO 1893.

The following additional notes on varieties fruited at this station in previous years are accompanied with references to notes previously published by this station.

Alpha, S. (*From T. T. Lyon, South Haven, Mich.*) This variety was introduced several years ago. It is not so early as Michel's Early and is too unproductive here to be profitable. Plants vigorous, fruit medium size, borne on medium stems, good quality, soft.

Auburn, P. (*From G. L. Miller, Stockton, Ohio*, 1891.) Fruit medium or above, good quality, moderately firm; stems medium size; foliage vigorous; yield unsatisfactory here.

Banquet, S. (*From J. R. Hawkins, Mountainville, N. Y.*) Few runners; not very good foliage; small to medium sized fruit, borne on short stems. Fruit does not ripen evenly, is very good in quality, moderately firm. Plants unproductive.

Beder Wood, S. (*From M. Crawford, Cuyahoga Falls, Ohio.*) A good, long season berry as noted on p. 491 of the annual report of this station 1891, and also on p. 674 of this report. While the fruit is neither of largest size nor of best quality the plants have usually given a satisfactory yield. Fruit rather soft. See bulletin 36, and annual report of this station 1891, p. 491; also bulletin 44 and report of 1892, p. 681.

Bessie, P. (*From A. H. Clark, Cambridge, Md.*) Foliage good; runners formed abundantly; stems good; fruit medium size, good quality, firm; yield not satisfactory. See following publications of this station: Bulletin 36, 1891, and annual report, 1891, p. 460.

Bowman, S. (*From M. Crawford, Cuyahoga Falls, O.*) Foliage fair to good; runners abundant; fruit stems short; fruit of light scarlet color, fair quality, firm. See also page 684 of report of this station, 1892, and bulletin 44, 1892.

Boynton, P. (*From M. Crawford, Cuyahoga Falls, O.*) Foliage badly burned in the dry weather at the beginning of the fruiting season; runners abundant; fruit stems medium; fruit medium size, fair quality, firm; plants unproductive here. See also bulletin 44 of this station and its annual report for 1892.

California, S. Fruit large, good quality, firm. Plants unproductive here.

Eclipse (*Barton's Eclipse*), P. Fruit quite uniform in size, medium, symmetrical, borne on medium stems; good quality, soft; runners abundant; foliage good. Yield not satisfactory here. See also bulletin 44 of this station and its annual report for 1892.

Edgar Queen, P. A late berry. It has not given satisfactory yield for the past two years, but this year (1893) it yielded well. See Table XIII, page 673. Fruit medium to large, good and moderately firm, borne on long stems; foliage vigorous; runners abundant. See also bulletin 36 of this station and its annual report for 1891.

Eureka, P. A late berry, medium or above, good quality, firm; makes runners freely, has excellent foliage, but the yield, though good, is not satisfactory here. See also bulletin 24 of this station and its annual report for 1890, p. 271.

Feicht's No. 2, S. (*From David Feicht, Dayton, O.*) Fruit medium or above, symmetrical, good quality, firm; stems long; foliage excellent; runners abundant. Season early but, as is usual with early varieties, its total yield for the season falls below that of standard later sorts. See bulletin 44 of this station and its annual report for 1892, pp. 684–5.

Feicht's No. 3, P. (*From David Feicht, Dayton, O.*) Foliage vigorous, but was slightly burned in the dry weather at the beginning of the fruiting season. Fruit medium to large, good quality, firm, midseason; stems long, runners abundant. Ranks fourth in productiveness this season. See bulletin 44 of this station and its annual report for 1892, p. 684.

Gandy, S. Fruit medium to very large, firm, and of very good quality. A late variety that produces excellent fruit, but its yield is unsatisfactory. See the following publications of this station: Bulletin 24, annual report, 1890, pp. 261 and 271, bulletin 36, and annual report, 1891, p. 464.

Gillespie, S. Not so productive here as Sharpless; medium to very large, fair quality, firm, light color; plants vigorous; runners abundant. See bulletin 44 of this station and its annual report, 1892, p. 685.

Gov. Hoard, S. Fruit medium size, fair quality, firm; runners abundant; foliage good. Yield good but not satisfactory. See also bulletin 44 of this station and its annual report, 1892, p. 685.

Great Pacific. Runners abundant, plants vigorous; fruit medium to large, borne on long, prostrate stems, firm and of good quality. See bulletin 44 of this station and its annual report for 1892, p. 685.

Greenville, P. (*From E. M. Buechley, Greenville, O.*) A midseason fruit of medium size, very good quality and moderately firm. Seems to be worthy of further testing. See bulletins of this station 36 and 44 and annual reports, 1891, p. 461, and 1892, p. 681.

Hatfield, S. Fruit of medium size, good quality, firm. Unproductive so far as tested here. See bulletin 44 of this station and annual report, 1892, p. 685.

Hazleton, No. 1, P. (*From John Hazleton, Delaware, O.*) Fruit medium to large, firm, very good quality; foliage good; runners abundant; fruit stems large. This variety has been fruited here three years and has proved only moderately productive. See bulletin 36 of this station and annual report, 1891, p. 462.

Hulburt, S. Foliage vigorous; runners abundant; fruit medium size, borne on medium stems, good, soft; plants moderately productive here. See bulletin 36 of this station and annual report, 1891, p. 461.

Laxton's Noble, S. Fruit midseason, medium to very large, good color, firm, fair quality; fruit stems medium; foliage vigorous, plants moderately productive here. See bulletin 44 of this station and its annual report, 1892, p. 685.

Louise. Fruit small to medium, borne on short stems, firm, good to very good in quality. Plants moderately productive, not vigorous. Runners few. Unproductive this season, but has done better here in previous years. See report of this station for 1889, p. 304; 1891, p. 462; bulletin 36, 1891.

Lovett, *Lovett's Early*, S. Midseason, medium size, good quality, moderately firm, moderately productive here. Foliage vigorous; runners abundant. See bulletin 44 of this station, also annual report, 1892, p. 685.

Michel's Early, S. Foliage vigorous, but was slightly burned in the dry weather at the beginning of the fruiting season; fruit stems medium; runners abundant. Fruit medium at first, afterwards small to medium, good quality, soft. It gave the largest yield before June 21 of any of the varieties fruited this season and it yielded no fruit after June 29. Its total yield for the season was not high since it ranks twenty-first as to yield for 1893, as stated on another page. See p. 673; see also bulletins 36 and 44 of this station and annual reports, 1891, p. 462; 1892, pp. 681–2.

Mount Holyoke, S. Foliage badly burned in the dry weather at the beginning of the fruiting season. Fruit midseason, medium to large, very good quality, firm. Runners abundant. Plants not very productive here. See bulletin 44 of this station and annual report, 1892, p. 485.

Ohio Centennial, S. Fruit large, firm and of fair quality, midseason to late. Fruit stems medium, foliage good, runners abundant. In the three years in which it has fruited here it has not taken high rank as to productiveness. See bulletin 36 and annual report, 1891, p. 463.

Oliver, S. (*From Phil. Strubler, Naperville, Ill.*, 1891.) Foliage healthy, plants vigorous, runners very abundant, fruit stems long. Fruit medium to large, good color, good quality, firm. Season late. This does not yield as well on this soil as Haverland or Middlefield, but does better than Sharpless. See also annual report of 1891, p. 463, and bulletin 36.

Parker Earle, S. Fruit medium size, good quality and moderately firm. Yield not satisfactory here. See bulletin 36 and annual report 1891, p. 463.

Phillip's Seedling, S. Fruit dark red or crimson, medium to large, soft, good quality, sometimes with imperfect tip; fruit stems long; foliage vigorous; runners abundant. During the three years it has been fruited here it has given large yields. See Table XVI, p. 676; see also bulletin 36 of this station and annual report, 1891, p. 463.

Waldron, P. Fruit midseason, medium size, borne on medium stalks, good quality, firm; runners abundant; foliage moderately vigorous. Yield unsatisfactory so far as tested here. See bulletin 44 of this station and annual report 1892, p. 686.

Walton, P. Foliage slightly burned in the dry weather at the beginning of the fruiting season; fruit midseason, borne on medium stalks, medium size, good quality, firm; foliage moderately vigorous; runners abundant. Moderately productive here. See bulletin 44 of this station and annual report 1892, p. 686.

Westbrook, P. Foliage burned in the dry weather at the beginning of the fruiting season. Fruit early to midseason, medium size, dark red color, moderately firm, good. Plants not very productive here. See bulletin 44 of this station and annual report 1892, p. 686.

Woolverton, S. Foliage somewhat better than that of Saunders, but was burned in the dry weather at the beginning of the fruiting season; runners abundant; fruit stems medium; fruit medium to large, good, firm; plants moderately productive. See bulletin 44 of this station and annual report 1892, p. 686.

LIST OF VARIETIES FRUITED AT THIS STATION IN 1893, NOT INCLUDING THE STATION SEEDLINGS.

Advance, see Meek's Early.
Advancer.
Accomack.
Alabama.
Allen's No. 1.
Allen's No. 3.
Alpha.
Anna Forest.
Arkansaw Traveller.
Auburn.
Banquet.
Barton's Eclipse, see Eclipse.
Beder Wood.
Belle.
Belle Bordelaise.
Bessie.
Beverly.
Bonnell's Seedling.
Bowman.
Boynton.
Bubach.
Burt, see Captain Jack.
California.
Cameronian.
Chair's Favorite.
Cheyenne.
Clark's Early.
Clyde.
Crawford's Seedling.
Crescent.
Crosby.
Crosby's No. 10.
Crosby's No. 91.
Curtis, No. 15.
Curtis, No. 154.
Custer.
Cycloma, see Clyde.
Dayton Early.
D and D.
Dew.
Dow's Seedling, see Epping.
Early Idaho, see Clark's Early.
Eclipse.
Edgar Queen.
Edwards' Favorite.
Engle's, No. 1.
E. P. Roe.
Everbearing.
Eureka.
Farnsworth.
Feicht's No. 2.
Feicht's No. 3.
Fragaria Virginiana.
Galerson.
Gandy.
Gandy Belle.
Gen. Putnam.
Gillespie.
Glenfield.
Great Pacific.
Greenville.
Gov. Hoard.
Hall's Seedling.
Hatfield.
Hazelton's No. 1.
Hazelton's No. 4.
Haverland.
Herbert.
Hoffman.
Holcomb's Seedling.
Hulburt.
Johnston's Late.
Jucunda.
Kincks.
Latest of All.
Laxton's Captain.
Laxton's Noble.
Lennig's White.
Lincoln.
Louise.

Lovett.
Magnate.
Manchester.
Martha.
May King.
Meek's Early.
Michel's Early.
Middlefield.
Mt. Holyoke.
Muskingum.
Ohio Centennial.
Oliver.
Oregon Everbearing.
Parker Earle.
Pawnee.
Phillip's Seedling.
Piper No. 4.
Primate.
Princess.
Prince of Berries.
Princeton Chief.
Racster, see Beder Wood.
Sadie.
Sandoval.
Saunders.
Sharpless.
Shaw.
Slaymaker & Son, No. 19.
Smeltzer's Early.
Smith.
Southard.
Stayman's, No. 1.
Stayman's, No. 3.
Street's Seedling.
Sunny Side.
Swindle.
Thompson's No. 9.
Thompson's No. 40.
Tippecanoe.
Townsend's No. 2.
Townsend's No. 3.
Townsend's No. 9.
Townsend's No. 20.
Triumph de Gand.
Van Deman.
Waldron.
Walton.
Warfield.
Westbrook.
West Lawn.
White Wilding, Fragaria Vesca.
Wilson.
Wilton.
Woolverton.
Yale.

LIST OF VARIETIES PLANTED IN 1893.

Aldridge No. 25.
Allen No. 5.
Allen No. 6.
Allen No. 13.
Allen No. 14.
Aroma.
Beauty.
Brandywine.
Cole's No. 14.
Columbia.
Cruse No. 9.
Cyclone.
Eureka.
Fragaria Californica.
Green Alpine.
Hayne's 31.
Honey Alpine.
Leader.
Luther.
Number One.
Random.
Red and Gold Alpine.
Riehl's No. 5.
Riehl's No. 6.

Rush.
Saunder's Success.
See No. 1.
See No. 2.
Sherman.
Shuckless.
Sierra Alpine.
Splendid.
Timbrell.
Townsend's No. 30.
Wilson Jr.

Early Varieties and Late Varieties.

Some strawberry growers find it to their advantage to raise early varieties, and frequently we are asked to name the varieties which have given the best yield at this station early in the season. This demand for very early sorts seems to come chiefly from growers who are supplying a local market and who find that the high prices received early in the season permit very early kinds to be grown with profit even when they are not so productive as later sorts.

By consulting the following table, p. 673, a comparison may be made of the thirty varieties of strawberries which gave the highest yields at this station in 1893 and their season of ripening may be noted. For convenience of reference the names are arranged alphabetically. In the first column is given the rank of the variety according to its yield at this station in 1893. The third column shows what per cent of its total yield was picked prior to June 21, 1893. The fourth column shows what per cent of the crop was picked after July 1, 1893.

TABLE XIII.—SHOWING RELATIVE YIELD OF THIRTY MOST PRODUCTIVE VARIETIES FRUITED AT THIS STATION IN 1893; ALSO PER CENT OF EARLY YIELD AND PER CENT OF LATE YIELD.

Rank as to yield, 1893.	NAME OF VARIETY.	Per cent of crop picked before June 21, 1893.	Per cent of crop picked after July 1, 1893.
26	*Allen's No.* 3, S	21	0
29	Beder Wood (*Racster*), S	32	6
*	Bowman,† S	14	0
...	*Burt*—see Capt. Jack	......	....
17	Captain Jack (*Burt*), S	16	15
16	Chair's Favorite, S	9	8
25	Crosby, S	6	8
30	*Crosby's No.* 91, S	0	10
*	Eclipse (*Barton's*),† P	16	0
2	Edgar Queen, P	0	35
18	Eureka, P	0	20
9	*Feicht's No.* 2,† S	55	0
4	*Feicht's No.* 3,† P	6	2
27	Gandy, S	0	25
*	Gov. Hoard,† S	18	0
*	Great Pacific,† P	0	1
22	Greenville, P	12	2
8	Haverland, P	7	11
17	*Hazleton's No.* 4,† P	0	14
28	Hulburt, S	36	0
*	Laxton's Noble,† S	16	0
23	Martha,† P	0	0
13	May King, S	7	4
21	Michel's Early, S	74	0
14	Middlefield, P	9	14
15	Ohio Centennial, S	0	23
19	Oliver, S	0	15
6	*Phillip's Seedling*, S	13	0
5	Princeton Chief, P	0	27
*	Sadie,† P	5	0
20	*Seedling from M. Crawford*, P	0	8
24	*Stayman's No.* 1,† P	0	8
1	Sunny Side, P	0	24
3	*Thompson's No.* 40, P	0	7
7	*Townsend's No.* 2, S	0	66
10	*Townsend's No.* 9, P	26	12
12	*Townsend's No.* 20, P	2	11
*	Waldon,† P	0	0
*	Walton,† P	0	6
*	Warfield,† P	0	0
*	Yale,† S	0	21

* Varieties marked with star cannot be given rank as to productiveness. After the fruiting season was over, it was discovered that the tile drains which passed under the plat where these varieties were located had undoubtedly received an unusual supply of water from the slope above, and thus their roots received a supply of moisture during portions of the dry season which the other varieties under test did not.

† Beds fruited for the second time in 1893.

As a rule the very early varieties do not give so high a yield as later sorts. It will be seen by consulting table XIV below, that the most productive variety classed as early, ranks ninth in total yield for 1893. The Michel's Early up to June 21 had ripened a larger amount of fruit than any other variety tested, yet it ranks twenty-first as to the total yield for the season; Beder Wood ripened nearly one-third of its crop prior to June 21, but this season it dropped to twenty-ninth in rank as to total yield; in 1891 it stood second, and in 1892 it stood first as to total yield for the season.

The above table shows that but five varieties gave more than one-fifth of their yield prior to June 21, 1893. This fact is sufficient reply to the oft repeated remark that there is practically no difference between the time of ripening of "early" and "late" strawberries. We see that there is a marked difference with different varieties as to their season of ripening.

Ranked according to their yield up to June 21, 1893, these five varieties stand:

TABLE XIV.—EARLY VARIETIES RANKED ACCORDING TO YIELD PRIOR TO JUNE 21, 1893.

NAME.	Date of first picking.	Ounces yielded before June 21.	Total yield.	Rank as to yield 1893.
Michel's Early, S	June 15	176	210	21
Feicht's No. 2, S	June 15	154	280	9
Townsend's No. 9, P	June 15	73	275	10
Hulburt, S	June 17	72	197	28
Beder Wood, S	June 15	64	196	29

Michel's Early gave the largest early yield and yielded no fruit after June 29. Feicht's No. 2 and Hulburt yielded no fruit after July 1. Greenville gave two per cent of its crop after July 1. For long season berries Townsend's No. 9 and Beder Wood took the lead. The latter gave six per cent, and the former twelve per cent of its yield after July 1.

Consulting table XIII (p. 673) with reference to the late varieties, but seven kinds are found that give more than one-fifth of their total yield after July 1. Ranked according to the amount of their crop picked after July 1 they stand:

TABLE XV.—LATE VARIETIES RANKED ACCORDING TO YIELD AFTER JULY 1, 1893.

NAME.	Date of first picking.	Ounces yielded after July 1.	Total yield.	Rank as to yield, 1893.
Townsend's No. 2, S	July 3	192	288	7
Edgar Queen, P	July 10	126	363	2
Princeton Chief, P	July 11	97	345	5
Sunny Side	July 10	96	400	1
Ohio Centennial, S	July 14	51	241	15
Gandy, S	July 7	50	197	27

Townsend's No. 2 gave the largest yield late in the season; and its fruiting season was very short. Two-thirds of its crop was picked between July 1 and July 4. Both Edgar Queen and Princeton Chief gave a higher total yield here this season than did Townsend's No. 2, and yielded fruit for a week after its fruiting season had closed. Their fruit is but moderately firm and not equal in quality to that of Townsend's No. 2.

The most productive berries at this station in 1893 are ranked according to their productiveness in the following table. Those varieties marked in table XIII with a star are not included in this list:

TABLE XVI.—LIST OF THIRTY MOST PRODUCTIVE VARIETIES* FRUITED AT THIS STATION IN 1893, ARRANGED IN THE ORDER OF THEIR PRODUCTIVENESS; THE RANK AT THIS STATION FOR THREE PRECEDING YEARS IS ALSO GIVEN.

NOTE.— Names of varieties fruited at this station for the first time in 1893 are in italics.

Rank, 1893.	NAME OF VARIETY.	Rank, 1892.	Rank, 1891.	Rank, 1890.
1	*Sunny Side*	......	......	......
2	Edgar Queen	......	24	......
3	*Thompson's No.* 60	......	......	......
4	Feicht's No 3 †	......	......	......
5	*Princeton Chief*	......	......	......
6	Phillip's Seedling	14	5	......
7	*Townsend's No.* 2	......	......	......
8	Haverland	16	13	8
9	Feicht's No. 2 †	......	......	......
10	*Townsend's No.* 9	......	......	......
11	Capt. Jack (*Burt*)	3	1	1
12	Townsend's No. 20	......	......	......
13	May King	......	......	......
14	Middlefield	9	......	2
15	Ohio Centennial	......	......	......
16	*Chair's Favorite*	......	......	......
17	Hazleton's No. 4†	......	......	......
18	Eureka	13	......	......
19	Oliver	......	......	......
20	Seedling from M. Crawford	......	......	......
21	Michel's Early	......	......	......
22	Greenville	2	3	......
23	Martha	......	......	......
24	Stayman's No. 1	......	19	4
25	*Crosby*	......	......	......
26	*Allen's No.* 3	......	......	......
27	Gandy	......	......	......
28	Hulburt	11	17	......
29	Beder Wood	1	2	......
30	*Crosby's No.* 91	......	......	......

SUMMARY.

1. Michel's Early and Feicht's No. 2 took high rank in 1893 as early strawberries.

2. Townsend No. 2, Edgar Queen, Princeton Chief and Sunny Side took high rank in 1893 as late berries.

3. Of the newer varieties tested in 1893, Sunny Side made the best record.

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* Excepting those varieties marked with * in Table XIII.

† Beds fruited the second year in 1893.

STRAWBERRY CROSSES.

Crossing strawberries for the purpose of originating improved varieties has received some attention at this station during the past few years. Brief accounts of the progress of this work have been given from time to time in its bulletins and annual reports. In 1885, Prof. Goff reported * that seedlings of Manchester and Bidwell had come into bearing and that the former were notably more vigorous and productive than the latter. Seed of Monarch of the West planted in 1882 gave seedlings which in 1885 yielded more, better and larger fruit than did an adjacent row of Wilson set at the same time.

One thousand seedlings fruited in 1888–9 are mentioned by Mr. Hunn in the eighth annual report, p. 307, with the statement that but twenty had shown indications of being superior to the parent varieties which included Chas. Downing, Crescent, Cumberland, Daniel Boone, Golden Defiance, James Vick, Legal Tender, Lennig's White, Manchester, Mrs. Garfield, Old Ironclad, Sharpless and Wilson.

In 1890† but fifteen of the twenty seedlings just noted were retained for further testing, and of seven hundred additional seedlings which had come into bearing but fifty were kept for further trial. The last one of all these seedlings was finally discarded this season (1893). Such a record appears, at first, rather discouraging. It should not be inferred, however, that among these hundreds of seedlings no valuable ones were found. On the contrary, valuable ones were found, but since they did not prove superior to the best varieties already introduced into cultivation they were discarded

During the winter of 1889–90 Mr. Hunn made several crosses of strawberries in the greenhouse which resulted in the production of many apparently excellent seedlings. In testing these seedlings, and those resulting from his later crosses, the same rule has been followed as formerly and none has been retained for further testing unless in some important point it gave promise of superiority to the best cultivated varieties of its class or season. The object of this work is not to introduce new varieties that are simply "good," but to secure, if possible, something superior to the kinds already cultivated.

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* Fourth Annual Report, pp. 226–7.

† Ninth Annual Report, 1890, pp. 274–5.

Over four hundred seedlings of Mr. Hunn's crosses were fruited this season (1893), and sixty-one of them have been reserved for further testing. Several of these are too delicate in color or too soft in flesh for market purposes and are being tested simply for home use. No doubt many and perhaps all of them may prove no more desirable than the best kinds already in cultivation and therefore will be discarded.

During the progress of this work of endeavoring to originate improved kinds of strawberries from seedlings of known parentage it has become evident that some of the cultivated varieties that have been used for parents are more desirable than others for this purpose. The differences observed in this regard will be discussed more fully below.

It is well known that cultivated strawberries are reproduced by means of runners* and they do not reproduce varieties true from seed any more than do cultivated apples or pears. For example, strawberry plants raised from Crescent seed do not produce Crescent strawberries. So far as our experience goes they do not produce so good fruit as the Crescent. Whenever new varieties arise, therefore, they must be obtained from seed. Possibly they may originate as sports from cultivated varieties but no instance of this kind is known to the writer.

At present but little is known as to the comparative ability of the named varieties of strawberries to produce seedlings of merit. In the history of gardening enough has been accomplished in the improvement of flowers and vegetables by selection of parents and by judicious crossing, to demonstrate that careful breeding secures as remarkable results with plants as with animals. When we reflect that of the hundreds of varieties of strawberries that have been introduced into cultivation, the parentage of but very few varieties is known, the improvement of cultivated strawberries does not seem beyond the realm of possibilities. If so great a number of good strawberries as we now have came into cultivation as chance seedlings, is it too much to expect that further improvement will reward systematic breeding?

Reference has been made on a previous page to the demand among a large class of strawberry growers for a late market berry. Some of the results thus far secured at this station encourage

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* Except some European varieties which are propagated by division of roots.

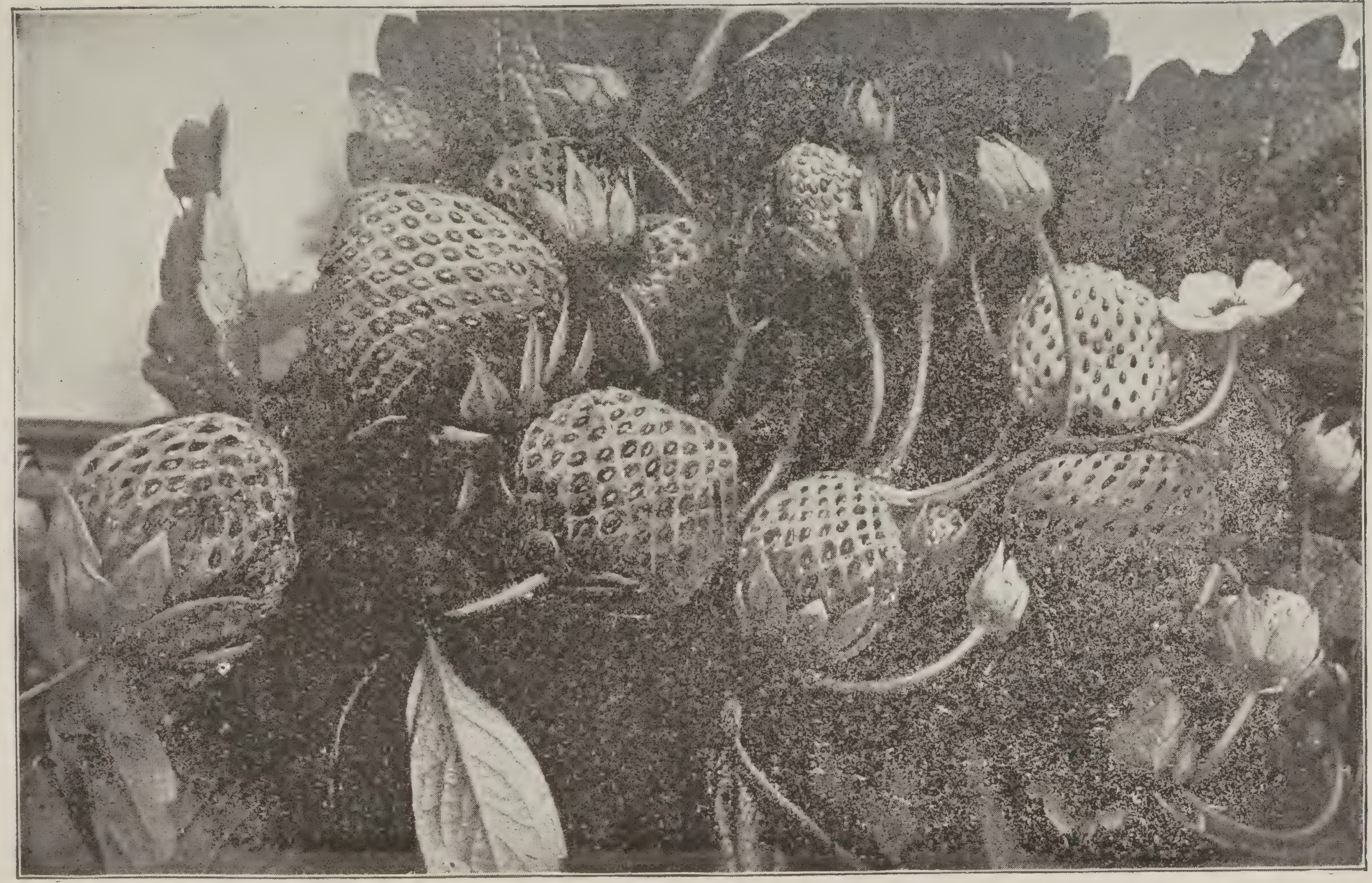


PLATE III.— Flower, foliage and fruit of No. 208 Station. A cross of Johnston's Late by Sharpless.

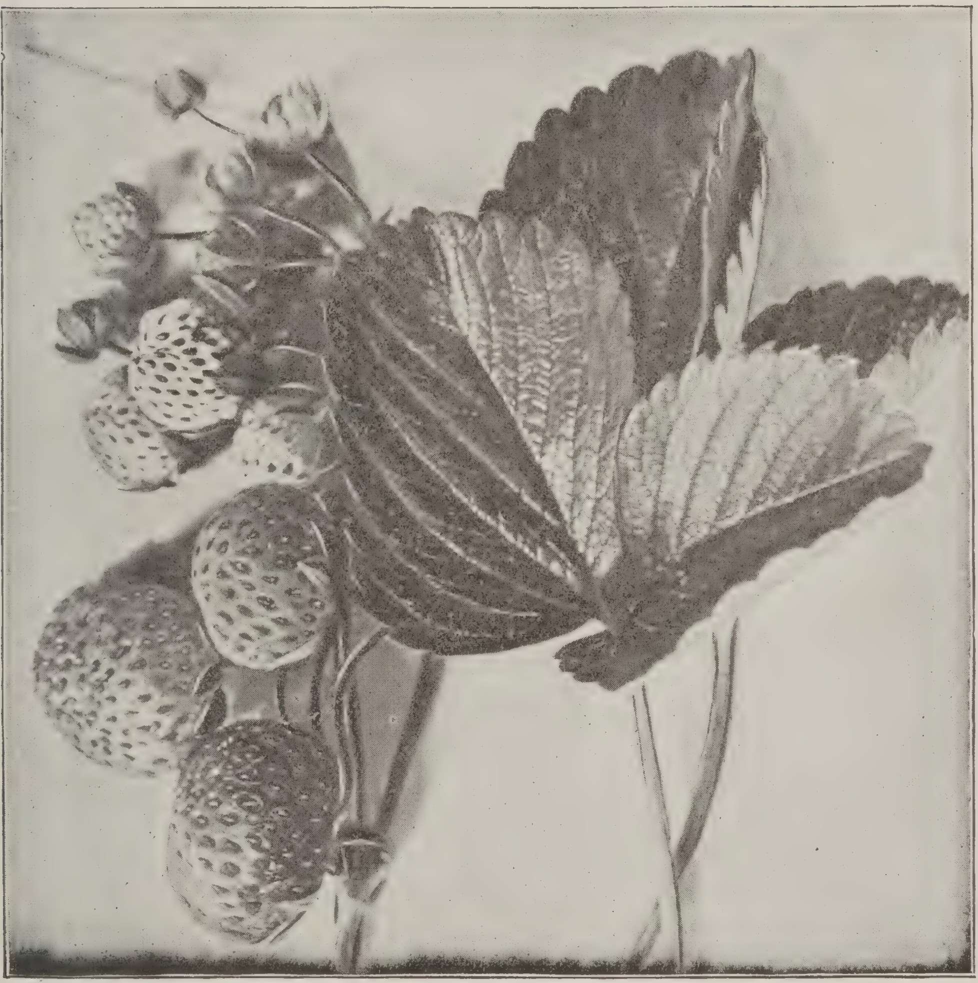


Plate IV.—Johnston's Late.

the belief that late market berries more desirable than any now cultivated may eventually be originated. Plate III, from a photograph, illustrates the fruit of one of the station seedlings which combines with late fruiting season many other desirable features. It has not yet been tested sufficiently to warrant its introduction. It is a cross of Johnson's Late by Sharpless and is of interest in this connection, because it combines in itself some of the most valuable characters of each of its parents, thus indicating the possibilities of improvement by systematic breeding. Sharpless, the male parent, is well known as a vigorous grower with large, dark green, coarsely serrated leaves, large, bright scarlet fruit, rather variable in form, sometimes with unripe tips. The flesh is firm, light red, and of good quality: Fruit ripens midseason to late.

The other parent, Johnston's Late, a variety not commonly known, is, in some respects, a remarkable strawberry. It is a chance seedling sent here in 1885 by R. Johnston, of Shortsville, N. Y. Its fruiting season is one of the very latest among the hundreds of varieties grown here during the last few years. The following table shows the dates at which it has ripened its first fruits for the past eight years, and also the dates at which Crescent, Manchester and Sharpless have ripened first fruits during the same period of years:

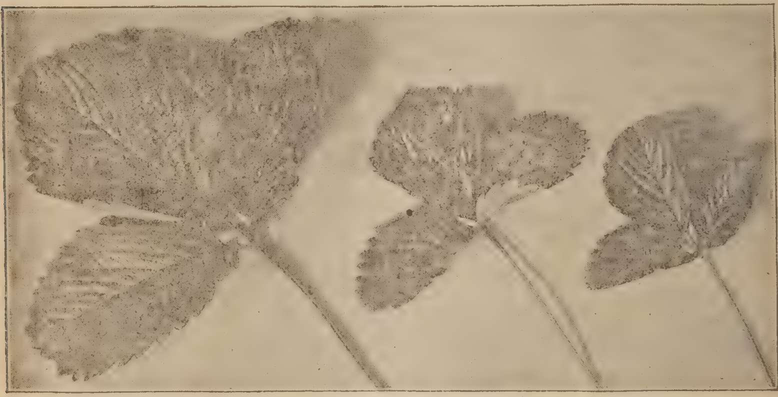
TABLE XVII.

YEAR.	FIRST FRUIT RIPE.			
	Manchester.	Sharpless.	Crescent.	Johnston's Late.
1886	June 10	June 11	June 4	June 24
1887	June 11	June 14	June 9	June 24
1888	June 25	June 25	*	July 2
1889	June 13	June 8	June 4	June 27
1890	June 19	June 17	June 16	June 28
1891	June 11	June 13	June 5	June 20
1892	June 18	June 19	June 13	July 2
	IN MARKETABLE CONDITION.			
1893	June 20	June 21	June 19	June 30
Avg. for eight yrs.	June 16	June 16	June 10	June 27

* Date not recorded.

By consulting this table it is seen that on the average during the last eight years Johnston's Late has ripened its first fruits eleven days later than either Manchester or Sharpless, and seventeen days later than Crescent. Its blooming season is correspondingly late, and since its flowers are imperfect this fact suggests a reason for its unsatisfactory yield. Possibly, if it were set near some staminate variety blossoming at the same late season, its yield would be much increased.

Another remarkable feature about Johnston's Late is its very dark, leathery leaves of medium size, and leaflets strongly marked by veins, suggesting that it may be derived, in part, at least, from *Fragaria elatior*, the hautbois strawberry of Europe. Plate IV, from a photograph, is an excellent illustration of the foliage and fruit of this strawberry. The fruit is medium to large, pale scarlet with white flesh of very good quality. An idea of the comparative size of the leaves on Johnston's Late, Sharpless and No. 208 is given by Fig. 2. The smallest leaf is from Johnston's Late, the next larger from Sharpless and the largest from No. 208, a cross of Johnston's Late by Sharpless. Average sized leaves of each variety were selected for this illustration. The cut is reproduced from a photograph and shows the leaves reduced much below natural size.



208 STATION.
A cross of Johnston's Late x Sharpless.
SHARPLESS.
JOHNSTON'S LATE.

FIG. 2.—*Illustration of foliage of Johnston's Late, Sharpless and No.* 208, *a cross of those two varieties.*

Nearly all of the seedlings of Johnston's Late produced at this station are easily recognized as distinct from ordinary cultivated strawberries because of their dark, leathery foliage, which in color, markings and texture bears a strong resemblance to that of Johnston's Late. Many of them also resemble Johnston's Late in the lateness of their blossoming and fruiting seasons and in the excellent quality of the fruit produced. Several of the seedlings obtained from crossing Johnston's Late by Sharpless, so far as tested here, combine the vigorous foliage and large fruit of Sharpless with the dark, leathery leaves and late fruiting season of Johnson's Late.

As stated on a previous page, p. 678, it is quite possible that every one of these promising seedlings, after more extended trial, may develop some serious defect, or may show no superiority over varieties now in cultivation and may consequently be discarded. Whether this fate awaits them or not, enough has been accomplished to show that the most rapid advance in the improvement of strawberries is to be expected in the direction of systematic breeding.

As noted above, some varieties used as parents of the crosses originated at this station, have given a much higher per cent of good seedlings than have others. This will become evident on examining the following table, XVIII, which indicates to some extent the comparative ability of the strawberries therein named to produce seedlings of merit.

TABLE XVIII.—SHOWING THE PARENTAGE OF THE VARIOUS CROSSES; THE NUMBER OF SEEDLINGS OF EACH CROSS TESTED IN 1893; THE NUMBER OF THESE DISCARDED IN 1893; THE PER CENT DISCARDED IN EACH CASE, AND THE RATIO OF THE WHOLE NUMBER TESTED TO THE NUMBER KEPT FOR FURTHER TESTING IN EACH CASE.

[In giving the parentage the female parent, as usual, is named first.]

PARENTAGE.	Number of seedlings tested in 1893	Number discarded, 1893	Per cent discarded, 1893.	Ratio of whole number tested in 1893 to number kept for further testing.
Crescent × Bomba	22	18	81.8	5.5 to 1
Crescent × Dawley	22	17	77.3	4.4 to 1
Crescent × Jessie	4	3	75.0	.4 to 1
Crescent × Lennig's White	100	93	93.0	14.3 to 1
Crescent × Old Ironclad	70	68	97.1	35.0 to 1
Crescent × Sharpless	59	46	77.9	4.5 to 1
Daisy × Lennig's White	5	5	100.0	5.0 to 0
Haverland × Jessie	7	7	100.0	7.0 to 0
Haverland × Sharpless	1	0	0.0	1.0 to 1
Johnson's Late × Dawley	3	2	66.6	3.0 to 1
Johnson's Late × Lennig's White.	41	37	90.2	10.2 to 1
Johnson's Late × Sharpless	18	12	66.6	3.0 to 1
Lida × Dawley	5	4	80.0	5.0 to 1
Lida × Lennig's White	9	6	66.6	3.0 to 1
Michel's Early × Lennig's White.	8	7	87.5	8.0 to 1
Stayman's No. 1 × Bomba	30	26	86.6	7.5 to 1
Stayman's No. 1 × Jessie	4	3	75.0	4.0 to 1
Stayman's No. 1 × Sharpless	5	2	40.0	1.7 to 1
Summit × Bomba	10	6	60.0	2.5 to 1

MALE PARENTS.

Bomba with mother plants from three different varieties gave sixty-two seedlings, twelve of which, nineteen per cent, were thought worthy of further trial. Of its crosses with Crescent, an average of four and a half seedlings were discarded to one retained; of its crosses with Stayman's No. 1, six and a half were discarded to one retained, and of its crosses with Summit, one and a half were discarded to one retained.

Dawley with mother plants from three different varieties gave thirty seedlings, nearly one-fourth of which, twenty-three per cent, are to be kept for further testing. It bears a very strong resemblance to Sharpless, and as a male parent it has given uniformly good results. Of its crosses with Lida, four were discarded on the average to each one retained; of its crosses with Crescent but three and four-tenths were discarded to one retained, and of its crosses with Johnston's Late, but two were discarded to one retained.

Lennig's White with mother plants from five different varieties produced 163 seedlings, nearly one-tenth of which, nine per cent, were kept for further trial; many of these, however, are to be tested simply for home use. Lennig's White was found to be very prepotent in transmitting to its progeny the color and shape of its fruit and the color and flavor of its flesh. The ripe fruits of its seedlings showed all shades of color from white to crimson. With some kinds the flavor was very poor while others of its seedlings produced fruit of fine quality with excellent flavor, equalling or surpassing the parent in this respect. Unfortunately some of the largest fruits of beautiful creamy pink color ranked very low in quality and flavor.

Of its crosses with Lida, but two seedlings on the average were discarded to each one retained; of its crosses with Michel's Early, seven were discarded to one retained; of its crosses with Johnston's Late, nine and two-tenths were discarded to one retained; of its crosses with Crescent, thirteen and three tenths were discarded to one retained, and of its crosses with Daisy every plant was discarded.

Old Ironclad with Crescent for mother plant gave seventy seedlings, but two of which, three per cent, were kept for further testing.

Sharpless as a male parent is remarkable for the general high character of its seedlings as shown by the relatively large number of them reserved for further trial with each of the four varieties on which it was crossed. Out of a total of eighty-three seedlings more than one-fourth, twenty-eight per cent, were kept for another season's test. Varieties of Sharpless parentage are particularly noticeable for the beautiful scarlet color and good quality of their fruit and for the vigor and productiveness of the plants. The crosses of Johnston's Late by Sharpless contain some seedlings of especial merit that may prove valuable for late market purposes.

Of its crosses with Crescent, but three and a half seedlings, on the average, were discarded to each one retained for further testing. This is the best record made by any variety thus far crossed on Crescent. Of its crosses with Johnston's Late, but two were discarded for each one retained; of its crosses with Stayman's No. 1, but seven-tenths of one was discarded for each one retained, and of its crosses with Haverland none was discarded.

FEMALE PARENTS.

Crescent showed great variability with different male parents as to the per cent of good seedlings produced, thus indicating lack of propotency so far as its desirable features are concerned. Out of a total of two hundred and seventy-seven seedlings a little more than one-tenth, eleven and five-tenths per cent, were kept for further testing. Of its crosses with Jessie, three seedlings on the average were discarded to each one retained; of its crosses with Dawley, three and four-tenths were discarded to one retained; of its crosses with Sharpless, three and a half were discarded to one retained; of its crosses with Bomba, four and a half were discarded to one retained; of its crosses with Lennig's White, thirteen and three-tenths were discarded to one retained, and of its crosses with Old Ironclad thirty-four were discarded to one retained.

Johnston's Late crossed with three different varieties gave a total of sixty-two seedlings of which more than one sixth, eighteen per cent, were reserved for further testing. Of its crosses with Dawley, two were discarded to every one retained; of its crosses with Sharpless, two were discarded to every one retained; of its crosses with Lennig's White, nine and two-tenths were discarded to one retained.

The prepotency of Johnston's Late in transmitting to its seedlings desirable characters of fruit, foliage and fruiting season have been discussed on a previous page, p. 680.

Lida crossed with two different varieties gave a total of fourteen seedlings of which more than one-fourth, twenty-eight per cent, were reserved for further testing. Of its crosses with Lennig's White, two were discarded to every one retained; of its crosses with Dawley, four were discarded to every one retained.

Stayman's No. 1 crossed with three different varieties gave a total of thirty-nine seedlings of which nearly one-fifth, twenty and five-tenths per cent, were kept for further testing. Of its crosses with Sharpless, seven-tenths of one seedling on the average was discarded for every one retained; of its crosses with Jessie, three were discarded for every one retained, and of its crosses with Bomba, six and a half were discarded to one retained.

The other mother plants being represented by but few seedlings need not be considered further in this connection.

About fifty of these crosses were exhibited fruiting in pots at the World's Fair, Chicago, last summer, and the exhibit received many words of commendation. Those who were interested in that exhibit will appreciate the high standard of merit adopted in testing these seedlings when it is stated that nearly all the varieties thus exhibited were afterwards discarded as unworthy of introduction.

SUMMARY.

I. Systematic breeding may be expected to give more rapid improvement of cultivated strawberries than will the introduction of chance seedlings.

II. **Johnston's Late** appears to be a desirable parent for use in breeding late varieties of strawberries.

III. **Lennig's White** was found to be very prepotent in transmitting the color, flavor and shape of its fruit to its seedlings. Its seedlings generally appear to be undesirable except possibly for home use.

IV. **Dawley** seedlings gave a large proportion of excellent varieties.

V. **Sharpless** seedlings gave a large proportion of excellent varieties, which were noticeable on account of the vigor and productiveness of the plants and the good scarlet color and good quality of the fruits.

SOME OBSERVATIONS ON THE LIFE-HISTORY OF PLOWRIGHTIA MORBOSA (SCHW.) SACC.

At the request of Mr. James Love, a nurseryman of Geneva, N. Y., the Horticulturist inspected a block of plum trees in his nursery June 28, 1893. The plums were budded in June, 1891, and the buds began to grow in the spring of 1892, so that this year the trees made their second season's growth. According to the usual custom of nurserymen, before the buds started to grow the entire tops of the stocks on which the buds were set were cut off close to the ground just above the insertion of the bud. The trees as they now stand have therefore no wood that is two years old above their union with the stock close to the surface of the ground.

The block of young plum trees is bordered on one side by a row of Bavay's Green Gage plum (*Reine Claude de Bavay*) in bearing, every tree of which is very badly diseased with the plum Black Knot, *Plowrightia morbosa* (Schw.) Sacc. The Bavay's Green Gage are thirty feet apart in the row and their branches overhang the outside row of the plums in the nursery, which are of the Gueii variety. After the foliage had fallen last autumn the knots in the Bavay's Green Gage trees were cut out. On June 28, 1893, nearly every tree of the young Gueii trees in the adjacent nursery row standing under the branches of the Bavay's Green Gage showed an outbreak of Black Knot either on the trunks or branches. The greater the distance of the Gueii trees from the Bavay's Green Gage the less Black Knot was found, and the portion of the nursery row midway between two Bavay's Green Gage trees contained but an occasional specimen of the Black Knot. The owner at first declared that no trees in the nursery row were affected with the Black Knot except those in the row adjacent to and overshadowed by the diseased Bavay's Green Gage, but careful inspection disclosed an occasional specimen of the disease in other rows. The conclusion was irresistible that the infection came from the Bavay's Green Gage trees.

1. Because there was no other adequate source of infection in the vicinity.

2. Because the area under the drip of the branches of the Bavay's Green Gage showed the disease in very great abundance, while outside this area only occasionally was a diseased nursery tree found. So marked was the area of greatest amount of disease that the owner was decidedly of the opinion that the infection came by the absorption of a poison by the roots of the young trees from the roots of the old trees.

The question as to how long a period of time may elapse after infection with the Black Knot spores before the appearance of conidia on the newly-formed knots may in this instance be answered quite definitely. The wood of the stock on which the Gueii were budded was all cut away prior to the summer of 1892, therefore the infection, in the great majority of cases at least, could not have come through the previous infection of the stock, for the outbreak of the Black Knot in most instances was at too great a distance from the stock to admit of the possibility of infection by growth of mycelium from that source; moreover, in no instance was the Black Knot observed below the union of the bud and stock. The infection could not have come from the ascopores during the winter and spring of 1893, because the owner asserts that the knots on the Bavay's Green Gage were cut away in the fall of 1892 and no old knots were noticed on these trees in June, 1893.

Although not the result of a direct experiment, the conclusion seems irresistible that the infection came from conidia produced in the summer of 1892. The first outbreak of the disease on the Gueii trees was observed June 18, 1893, when eleven fresh spongy knots were found. Had any outbreak occurred much previous to this time it could hardly have escaped the observation of those who cultivated the trees. No outbreak of the disease on the Gueii trees was observed during 1892, the season in which the infection took place. Within a few days after the first knots were seen on the Gueii, June 18, 1893, the disease appeared in great abundance in the infected areas.

In this instance there seems to be no reason to doubt that trees which were infected with *Plowrightia morbosa* (Schw.), Sacc., received the infection during the season of 1892, and that the first conidia formed as a result of this infection were produced in June, 1893.

A point of economic interest is also emphasized by these observations, namely, that a very serious outbreak of the Black Knot may follow an infection from the conidia which are formed only during the summer months. Infection from this source is to be feared as well as from the ascopores matured in late winter and early spring.

PREVENTING LEAF BLIGHT OF PLUM AND CHERRY NURSERY STOCK.

During the years of 1891 and 1892 Mr. D. G. Fairchild, assistant in the United States Division of Vegetable Pathology conducted some very valuable experiments in spraying nursery stock at this station. The progress of the work in 1891 was noted in Bulletin No. 3 of the United States Division of Vegetable Pathology and a report of the work of 1892 was given in Vol. VII., pp. 240–264, of the Journal of Mycology, published by the same Division, and also in the last annual report of this station, pp. 642–673.

Since these publications are probably accessible to any who are interested in these investigations it will be sufficient in this connection to make a very brief statement of the results of the experiments.

The experiment designed to compare the efficacy of the ammoniacal solution of copper carbonate and the Bordeaux mixture against the plum leaf blight on cherry nursery stock resulted in a more favorable showing for the latter.

On Mahaleb stock, both Windsor and Yellow Spanish cherries did better under Bordeaux mixture treatment than without any treatment.*

On Mazzard stock the treated cherry trees were superior to the untreated; the Bordeaux mixture was slightly superior to

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* Jour. Myc., VII, p. 251; Annual Rep. N. Y. State Expt. Station, 1892, p. 657.

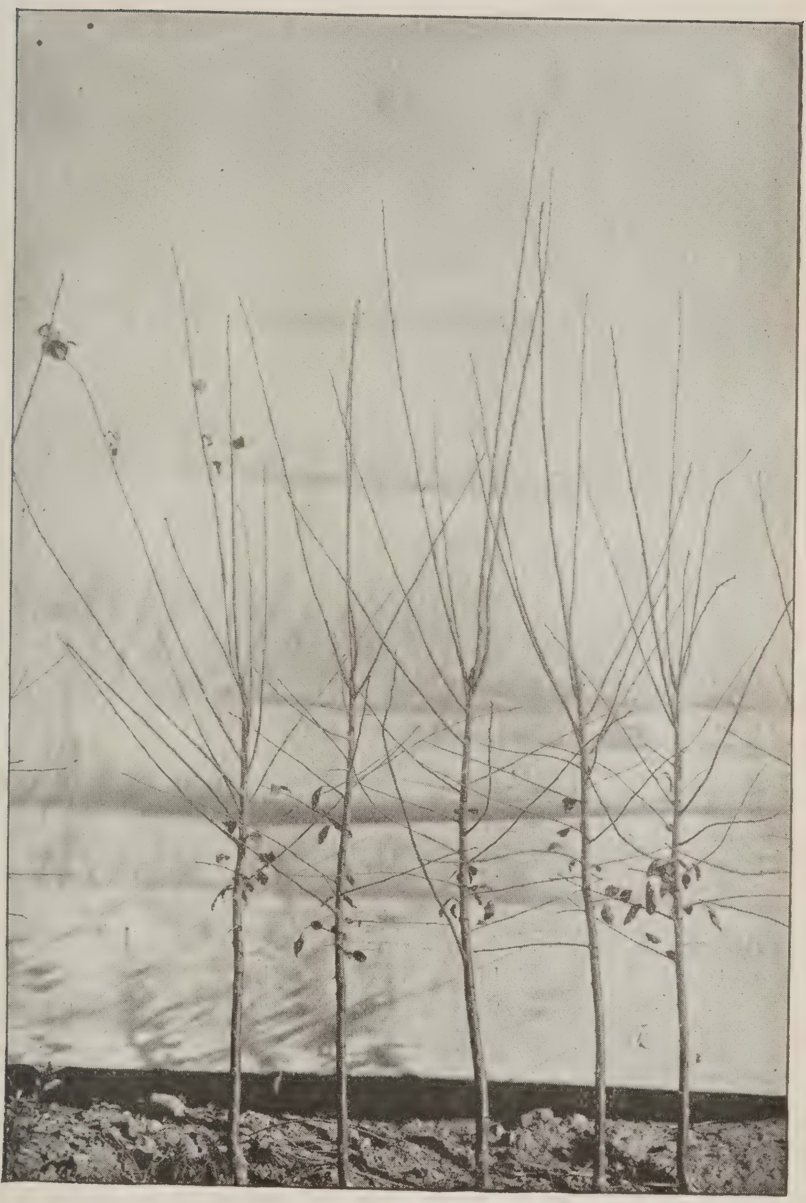

PLATE V.— Purple Egg on Marianna Stock not sprayed.—Oct. 10, 1893.

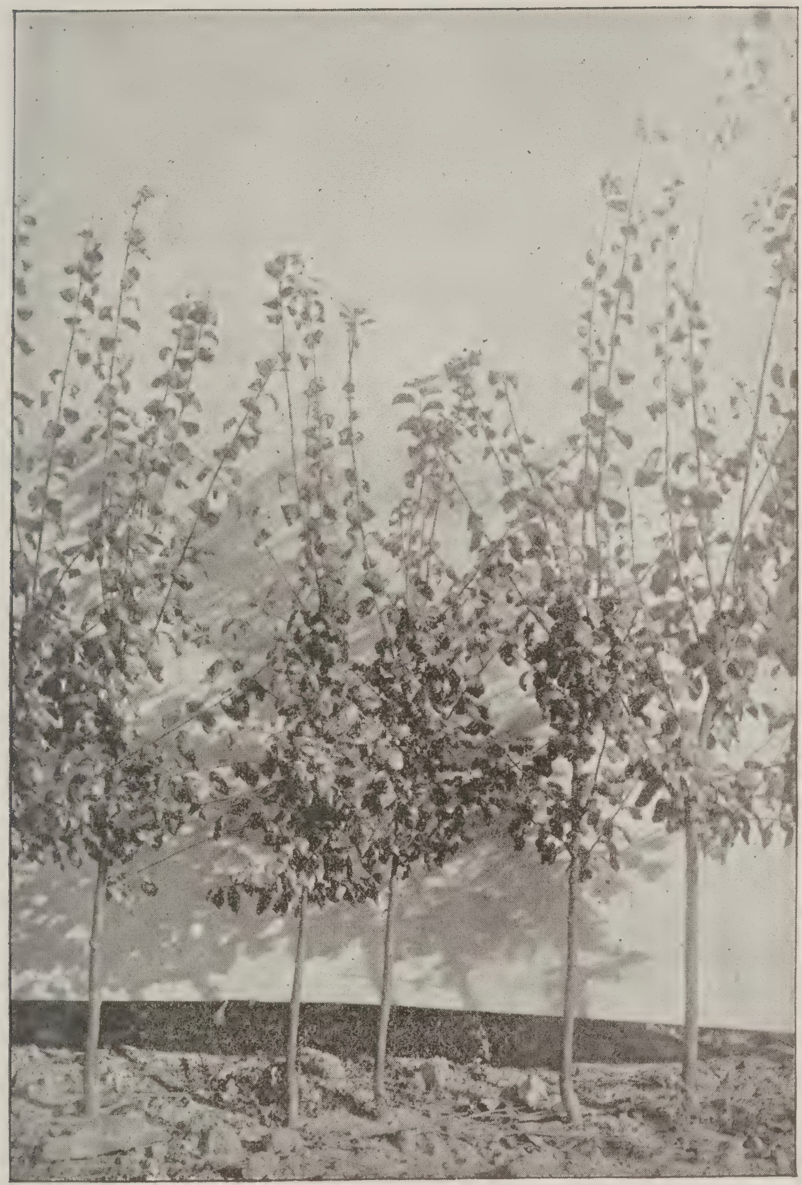

PLATE VI.— Purple Egg on Marianna Stock, sprayed June 13 and July 14 with Bordeaux Mixture, 1 pound to 11 gallons.— Oct. 10, 1893.

the ammoniacal solution of copper carbonate when six treatments with each are compared; the ammoniacal solution of copper carbonate was evidently injurious to the health of the foliage.*

With plums on Myrobolan stock the fungicides proved effective in that the treated trees lost only a small number of leaves as compared with the untreated trees.

On Marianna stock the treatment prevented the leaf blight to a notable degree.† The ammoniacal solution of copper carbonate proved inferior to the Bordeaux mixture since it injured the treated foliage.

Experiments of 1893.

At the request of several nurserymen who were much interested in the above-mentioned experiments, after consulting with Mr. Fairchild, it was decided that the Station Horticulturist should continue the treatment of the plums and cherries during 1893 with those trees which had been sprayed with Bordeaux mixture, but to discontinue the treatment with those trees which had been sprayed with ammoniacal solution of copper carbonate, since the previous years investigations had shown that this solution was injurious to the foliage.

The nursery stock included in the experiment consisted of the same trees with which Mr. Fairchild had conducted his investigations during 1891 and 1892, and the plan of the nursery may be seen by referring to the publications above mentioned. The buds were set in 1891, and the trees in 1893 were, therefore, making their second season's growth from the bud.

Cherries.

The cherry stock consisted of Windsor, Yellow Spanish and Montmorency on Mahaleb and also the same varieties on Mazzard. Although the leaf blight had been prevalent among these trees in 1892,‡ they were practically free from the disease in 1893, and the treated trees consequently showed no appreciable advantage over the untreated trees. They were given the same treatment as that hereafter described for plums.

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*Jour. Myc., VII, p. 252; Annual Report of N. Y. State Expt. Station, 1892, p. 658.

†Jour. Myc., VII, 255; Annual Report N. Y. State Expt. Station, 1892, p. 662.

‡Jour. Myc., VII, pp. 252 and 254, plates XXVI, XXVII; Annual Report N. Y. State Expt. Station, 1892, pp. 656 and 658, plates 25 and 26.

Plums.

The plums consisted of the three varieties, Early Prolific, Purple Egg and Italian Prune on Myrobolan and the same varieties on Marianna. Those trees which in the previous seasons had been sprayed with the Bordeaux mixture were treated with the same mixture in 1893, and all other trees were left untreated for comparison. Two treatments were given, one June 13 and the other July 14.

The leaf blight was abundant among the plums. The sprayed trees held their leaves about a month later and also made a much better growth than did the unsprayed trees. The latter began to drop their leaves early in the autumn, and by October 10th most of their branches were entirely leafless, while the sprayed trees held their foliage much later and did not become entirely defoliated till about a month after the unsprayed trees had become leafless.

ON MARIANNA STOCK.

TREATMENT.		NAME AND NUMBER.	Average caliper thirty-seconds of an inch.	Aver'ge weight of tops.	Aver'ge weight of roots.
1891–2.	1893.				
				Ounces.	Ounces.
Ammoniacal 5 times	None	6, Early Prolific	19.4	7.3	4.5
Ammoniacal 6 times	None	14, Early Prolific			
Bordeaux 5 times	Bordeaux twice	14, Early Prolific	26.5	23.6	8.3
Bordeaux 6 times	Bordeaux twice	4, Early Prolific			
None	None	7, Early Prolific	19.5	7.0	3.5
Ammoniacal 5 times	None	13, Purple Egg	29.3	20.1	8.6
Ammoniacal 6 times	None	22, Purple Egg			
Bordeaux 5 times	Bordeaux twice	17, Purple Egg	29.6	27.1	9.2
Bordeaux 6 times	Bordeaux twice	13, Purple Egg			
None	None	25. Purple Egg	25.2	9.7	5.7
Ammoniacal 5 times	None	16, Italian Prune	20.6	9.2	4.4
Ammoniacal 6 times	None	15, Italian Prune			
Bordeaux 5 times	Bordeaux twice	14. Italian Prune	25.9	13.9	7.3
Bordeaux 6 times	Bordeaux twice	16, Italian Prune			
ON MYROBOLAN STOCK.					
Ammoniacal 5 times	None	9, Early Prolific	19.2	6.2	5.5
Ammoniacal 6 times	None	13, Early Prolific			
Bordeaux 5 times	Bordeaux twice	15, Early Prolific	23.6	12.5	7.6
Bordeaux 6 times	Bordeaux twice	13, Early Prolific			
None	None	7, Early Prolific	16.4	5.5	3.8
Ammoniacal 5 times	None	11, Purple Egg	26.5	10.7	7.9
Bordeaux 5 times	Bordeaux twice	13, Purple Egg	25.4	18.1	8.6
Bordeaux 6 times	Bordeaux twice	13, Purple Egg			
None	None	10, Purple Egg	22.6	9.2	7.1
Ammoniacal 5 times	None	10, Italian Prune	23.7	9.6	6.4
Ammoniacal 6 times	None	14, Italian Prune			
Bordeaux 5 times	Bordeaux twice	14. Italian Prune	25.6	11.5	8.0
Bordeaux 6 times	Bordeaux twice	14. Italian Prune			
None	None	9, Italian Prune	21.4	8.2	6.0

The comparative condition of the sprayed and unsprayed trees is well shown by plates V and VI. Plate V, from a photograph October 18, 1893, shows the almost complete defoliation of the untreated trees at this date, while plate VI, also from a photograph, shows the manner in which the sprayed trees were holding their foliage at this time.

The benefit of the treatment was seen not only in the more perfect foliage of the sprayed trees, but also in their increased growth, as evidenced by the increased weight of both tops and roots, and by the larger diameter when calipered five inches above the collar. The weights and measurements are given in the preceding tables.

It will be noticed that in every instance the Bordeaux treatment gave heavier trees than no treatment, and with a single exception gave trees of larger caliper. This exception might be due to inequality of soil conditions. The general evidence of the experiments shows conclusively the beneficial results of the spraying.

The strength of the Bordeaux mixture used in this work was one pound of copper sulphate and the necessary amount of lime to eleven gallons of water. The Nixon Climax pump, made at Dayton, Ohio, and the Vermorel nozzle were used.

In preparing the Bordeaux mixture the required amount of copper sulphate was dissolved and diluted to about two-thirds of the required strength; the fresh slaked lime was then poured into this solution in the form of a thin whitewash until the potassium ferrocyanide test showed that a sufficient amount of lime had been added. The mixture was then diluted to the required strength. When the lime is poured into the solution care should be taken to to keep out any coarse sediment that might clog the nozzle.

The copper sulphate will dissolve more readily in hot water than in cold. It also dissolves more readily if suspended near the top of the water than when lying on the bottom of the barrel or tank in which it is dissolved.

Stock solution.— It is best to use freshly prepared Bordeaux mixture, but the lime and the copper sulphate solution may both be kept prepared for use and thus much time may be saved in making the mixture. The lime may be slaked in a barrel or box partly buried in the ground. By keeping the lime covered with water it will keep in good condition for an indefinite length of time. The copper sulphate may be dissolved in large quantities and the proper quantity of this solution may be measured out whenever needed. In all except experimental work our plan is to dissolve a large quantity of the copper sulphate, using one gallon of water for every two pounds of sulphate. Before using this solution it is thoroughly stirred each time and then the required amount is measured out. Thus if the formula calls for four pounds of copper sulphate, two gallons of this solution are required. It should never be dissolved or kept in iron vessels, since it corrodes the iron.

Weighing and straining the lime.—It was formerly thought necessary to strain the milk of lime into the copper sulphate solution and a coarse sieve or a gunny sack was commonly used for this purpose, but it is found except where the nozzles are not directed by an operator but are stationary, that the operation of straining is unnecessary if care is used in pouring. The clear lime water is not sufficient but the lime mixed with the water must be used.

The amount of lime necessary to form the Bordeaux mixture was formerly determined by weighing, using two-thirds as much lime as copper sulphate but by means of the potassium ferrocyanide test the necessity of weighing the lime is now obviated.

Potassium ferrocyanide test.— Pour the lime into the copper sulphate solution, stir the mixture thoroughly and then add a drop of the potassium ferrocyanide. If enough lime has been added the drop will not change color when it strikes the mixture, otherwise it will immediately change to a dark reddish brown color. More lime must then be added till the potassium ferrocyanide does not change color when dropped into the mixture.

The potassium ferrocyanide, also known as the yellow prussiate of potash, is a poisonous substance. It is a yellow salt which readily dissolves in water and a solution may conveniently be kept on hand in a small bottle. The commercial form of the potassium ferrocyanide may be used. A few cents should purchase enough to last through the season.

Excess of lime.— It is important that enough lime be added, otherwise the mixture may injure the foliage, while an excess of lime will not harm the foliage.

SUMMARY.

1. In 1892, cherry nursery stock was successfully treated by Mr. Fairchild, for the prevention of leaf blight. The same trees treated again in 1893, showed no benefit from the treatment because both treated and untreated trees were practically free from the disease.

2. In 1892, plum nursery stock was successfully treated with Bordeaux mixture for leaf blight by Mr. Fairchild. The same trees were again successfully treated with the same mixture in 1893. The good effects of the treatment were shown in the increased growth of both tops and roots and in the healthier foliage. The foliage remained attached to the branches about a month later than did the unsprayed foliage.

Experiments in Preventing Pear Scab.

Some experiments in 1893, in treating pear trees for the prevention of the pear scab and the cracking of the fruit, were very successful in accomplishing the desired objects. The plan of the experiments was:

1. To test the efficacy of dilute Bordeaux mixture against pear scab.

2. To compare the efficacy of three sprayings before the blossoms open with two sprayings before the blossoms open.

The Horticulturist* called attention a year ago to the discovery by Fairchild of the fact that pear scab appears on the new growth before the blossoms open, and that subsequently his own investigations showed the same was also true of the nearly related fungus causing the apple scab. A knowledge of these facts modified somewhat pre-existing opinions as to the importance of spraying before the blossoms open and led to the belief that the treatment of either pears or apples for the prevention of the scab would be more successful if more attention were given to spraying the trees thoroughly after the buds opened, but before the blossoms unfolded. The experiments with pears in 1893 were, therefore, so planned as to test not only the efficacy of spraying before the blossoms opened, but also to test the value of three treatments before blooming, compared with two treatments before blooming.

In the above mentioned paper on "Latest Results in Spraying for Apple Scab," it was shown that the leading investigators of the United States and Canada were almost unanimous in their verdict for the Bordeaux mixture as being, on the whole, the most satisfactory fungicide yet tested for the apple scab and many of them made special mention of dilute Bordeaux mixture as being most desirable for this purpose. The fungus which causes pear scab, though not identical with the fungus which causes apple scab, is nearly related to it and resembles it very much in general appearance and in habits of life, so far as these habits are at present known. Since the dilute Bordeaux mixture had given such good results when used against the apple scab it was thought that it might also prove effective against pear scab. For this reason the experiments with pears in 1893 were planned so as to test the efficacy of the dilute Bordeaux mixture against pear scab. No attempt was made to compare the merits of different fungicides.

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* Beach, S. A., "Latest Results in Spraying for Apple Scab." Proc. Western N. Y. Hort. Soc'y, 1893, pp. 69–72, also pp. 504–8 of Trans. N. Y. State Ag'l Soc'y, 1892.

A large old orchard near the Experiment Station, situated on the upland, about two miles west of Seneca lake, offered a most favorable opportunity for the proposed investigation, and the owners, Messrs. E. Smith & Sons, very kindly offered the use of it for this purpose free of charge.

Some varieties in the orchard were particularly susceptible to to the attacks of the scab, and on account of the prevalence of the scab for several years had produced comparatively little first-class fruit. Two of these varieties, namely, White Doyenné and Seckel, were accordingly selected for treatment. The White Doyennés were used simply to test the efficacy of the dilute Bordeaux mixture. The Seckel trees were used for the double purpose of testing the efficacy of the dilute Bordeaux mixture and also for comparing the value of two treatments before blooming with three treatments before blooming. Several other interesting and practical questions invited investigation, but it was thought best not to complicate the experiments by trying to make them answer too many questions at once, and, therefore, attention was directed chiefly to the two objects just mentioned, namely:

1. To determine the value of the dilute Bordeaux mixture for preventing pear scab.

2. To determine the best number of treatments prior to blooming.

In one part of the orchard three rows of Seckel trees were selected for the experiment. Each row originally contained thirty-six trees, but there are now some vacant places and occasionally a tree of some other variety is found so that the number of Seckel trees, included in the experiment was but sixty-four, of which number fourteen were sprayed six times, fourteen were sprayed five times and thirty-six were left untreated for comparison.

Fourteen White Doyenné trees located in another part of the orchard, were also selected for the experiment. Six of these were treated five times and the remaining eight were left untreated for comparison.

Dates of Spraying.— The first spraying, given to one block of Seckels only, was made May 2. When this spraying was made some of the fruit buds were bursting, but the leaf buds had not as yet shown their first green tips. The same evening a rain storm set in and continued through the next day and into the following night.

The next spraying, given May 10, was applied to all the trees designed for treatment during the season and all these trees were subsequently treated alike. This was the second spraying for the block of Seckels treated May 2 and the first spraying for the White Doyennés and for the other block of Seckels.

When the next treatment was made, May 19, the first blossoms were beginning to open.

The next treatment was made May 31, when the last blossoms were falling. To each cask of the mixture were now added four ounces of Paris green, making one ounce of the Paris green to about eleven gallons of the mixture. This was used to destroy the codlin moth and other biting insects.

The next spraying was made June 12, and Paris green was added as before. Paris green was also used with the last spraying, which was made June 28. Notes made at this time state that the scab spots were more abundant on the unsprayed Seckel fruits than on the fruits of the unsprayed White Doyenné, but at the close of the season it was evident that the latter were damaged by the scab much more than the former, thus showing that the scab may continue to develop throughout the summer. July 18 it was noted that nearly every fruit on the lower branches of the sprayed trees was perfect while on the unsprayed trees nearly every fruit was blemished by the scab, some fruits being but slightly affected, while others were badly injured. This difference between the sprayed fruit and the unsprayed fruit became more and more noticeable as the season advanced.

The top branches of trees twenty-five feet high were not easily reached by the spray, and most of the imperfect fruit found on the sprayed trees came from the tops of the tall trees.

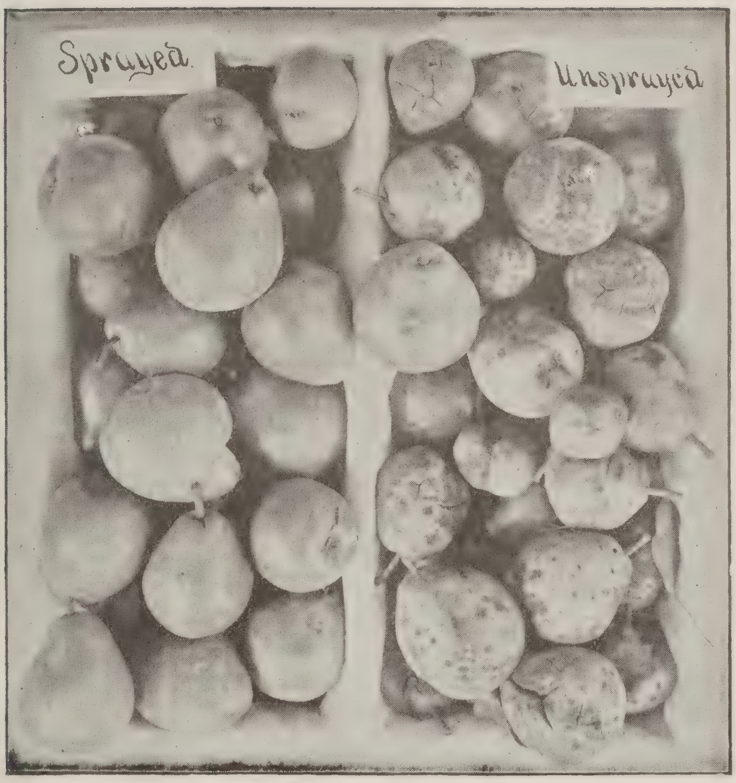

PLATE VII.-- From a photograph of average fruit of sprayed White Doyenné and average fruit of unsprayed White Doyenné.

Method of application.— In spraying this orchard in 1893 the force pump was mounted on a kerosene cask holding about fifty gallons. The pump was provided with two outlets, so that it supplied two leads of hose. The cask was set in a one-horse wagon and filled with forty-five gallons of Bordeaux mixture at a time. The driver pumped and while one man sprayed the lower branches with the Vermorel nozzle another sprayed the tree tops with the McGowen nozzle. In planning to treat large orchards a tank holding from one hundred and fifty to two hundred gallons would be better than a fifty-gallon cask, because less time would be consumed in making the mixture and taking it to the orchard.

The fruit was picked the fourth week in September and assorted into three grades, namely, firsts, seconds and culls. The firsts and seconds were marketed. No use was made of the culls. Plate VII is reproduced from a photograph of the average fruit of sprayed White Doyennés and the average fruit of unsprayed White Doyennês. It will help to form a correct idea of the difference on the average between the sprayed and the unsprayed fruit of this variety. With Seckels the difference was less marked.

The grading and marketing was done by Mr. William Smith according to his usual custom, and a record was kept of the sales. He reports that the following prices were realized for the different grades of fruit:

TABLE XIX.

	Sprayed.	Unsprayed.
Seckels:		
Firsts	$2.25 to $2.75 per bu. keg.	$1.25 to $1.75 per bu. keg.
Seconds	1.75 to 2.00 “ “	1.00 to 1.30 “ “
White Doyenné:		
Firsts	4.50 per bbl. (1.80 per bu.)	None.
Seconds	3.25 “ 1.30 “	$2.00 per bbl. (0.80 per bu.)

There was no first-class fruit among the unsprayed White Doyennês. Much of the second-class fruit from the unsprayed White Doyennés was unfit for market and was not sold. What was sold brought the price above named. In the following table the unsold fruit of this class is credited with the market price as if it were sold. At the above prices the average yield per tree would give the following receipts:

TABLE XX.

VARIETY.	Number of treatments.	Receipts per tree.	* GAIN FROM TREATMENT.	
			Per tree.	Per 100 trees.
Seckel	Six	$5.48 to $6.67		
Seckel	None	.68 to .90	$4.80 to $5.77	$480.00 to $577.00
Seckel	Five	5.70 to 6.92		
Seckel	None	.93 to 1.26	4.77 to 5.66	477.00 to 566.00
White Doyenné	Five	6.55		
White Doyenné	None	.45	6.10	610.00

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* Not counting the cost of the extra packages and handling of the increased yield.

As noted above, not all the seconds of the unsprayed White Doyennés were sold so that the gain from treatment of this variety as shown in the above table appears less than it really was.

Comparing simply the lowest returns per tree as given in the preceding table it is seen that the receipts from the Seckels sprayed six times average five dollars and forty-eight cents

per tree, while the receipts from the corresponding unsprayed Seckels average sixty-eight cents

per tree.

The receipts from the Seckels sprayed five times average five dollars and seventy cents

per tree, while the receipts from the corresponding unsprayed trees average ninety-three cents

per tree.

The receipts from the White Doyenné sprayed five times average six dollars and fifty-five cents

per tree, while the average receipts per tree from the unsprayed White Doyenné were forty-five cents.

Referring again to the same set of figures, if the average receipts per tree from the Seckels sprayed six times be represented by

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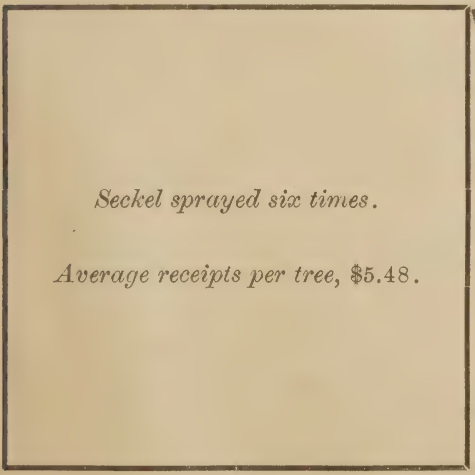

Then the average receipts per tree from the corresponding unsprayed Seckels will be represented by

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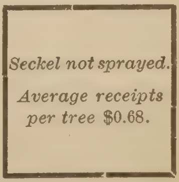

So, also, if the average receipts per tree from the Seckels sprayed five times be represented by

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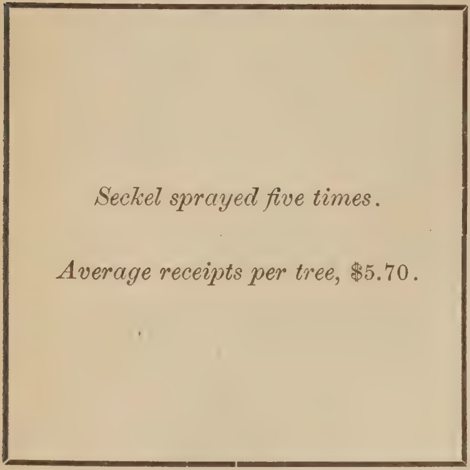

Then will the average receipts per tree from the corresponding unsprayed Seckels be represented by

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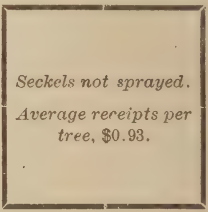

If the average receipts per tree from the White Doyennés, sprayed five times, be represented by

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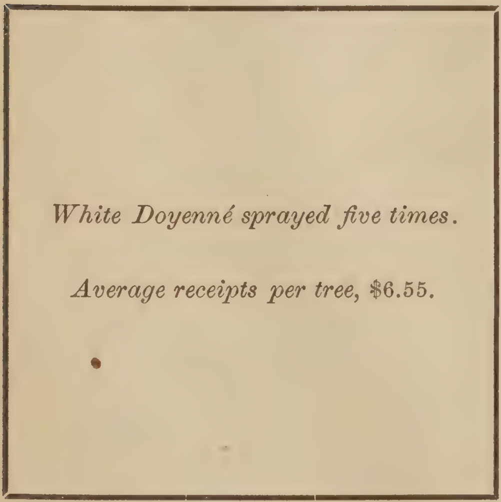

Then will the average receipts per tree, from the corresponding unsprayed trees, be represented by

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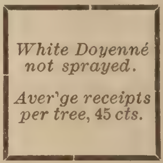

About three weeks before the pears were picked a severe wind storm blew off many bushels of fruit. There can be no doubt that but for this unavoidable occurrence the showing would be much more favorable to the sprayed trees than it actually is.

Cost of Treatment. The cost of treatment was as follows, counting the cost of the mixture at one-half cent per gallon:

First treatment (average gallons per tree, 3.3)	$0.0165
Second treatment (average gallons per tree, 5.0)	.0250
Third treatment (average gallons per tree, 7.07)	.0353
Fourth treatment (average gallons per tree, 9.0)	.0400
Fifth treatment (average gallons per tree, 9.0)	.0400
Sixth treatment (average gallons per tree, 9.0)	.0400
Average cost of material per tree for six treatments	$0.1968
Average cost of labor per tree for six treatments	0.3561
Average total cost per tree for six treatments	0.553
Average cost per treatment per tree	.092
Average total cost per tree for five treatments	0.476
Average cost per treatment per tree	.095

Not including the cost of packing and handling the increase in the crop resulting from spraying, the gain per hundred trees from the spraying varied from $424.70 to $562.40. For several years past these trees have been quite unprofitable on account of the attacks of pear scab. The trees are about thirty-five years old and the largest of them are from twenty-five to thirty feet high. They have been given but little, if any, pruning in recent years and the tops are, therefore, very dense, making it difficult to spray them thoroughly. The spraying of these trees was more expensive both in labor and in material than it would have been with open top trees of the same size. All who have had experience in spraying orchards will agree that the cost of the treatment as here given is very high, even for trees of this size. Those who will trim their trees properly and plan to spray the entire orchard will no doubt be able to treat even large trees at less cost per tree than that given above. While the profit from treatment as shown in these experiments is probably much above the gain that may ordinarily be realized from even those varieties specially subject to the attacks of the scab, yet in these experiments the gain from spraying might have been greater than it really was had it not been for the loss of so much fruit by the wind storm, as previously stated, and had the tree tops been less dense.

The treated Seckel trees were in two blocks, one of which was surrounded by untreated infected trees, while the other block was also hemmed in on three sides, by infected trees. The White Doyenné trees were somewhat scattered, but in most instances the sprayed trees were separated by a short distance only from unsprayed, infected trees. In considering the results of these experiments it is well to bear in mind the fact that the sprayed trees were thus constantly open to infection from adjacent trees that were not sprayed. Evidently, when an entire orchard is sprayed this source of infection may be obviated in a large measure.

Effect on the foliage.— It should also be remarked that the five hundred and sixty-two dollars gain per hundred trees from the sprayed fruit (see p. 701) does not represent in this case all the benefit resulting from the spraying. Early in the season the foliage of the sprayed trees was of a more healthy color than was the foliage of the unsprayed trees. Later in the season this difference was very marked, and on account of having healthier foliage the sprayed trees evidently went into the winter in better condition and are better prepared for a good crop in 1894 than are the unsprayed trees. It was also noted that during the wind storm above mentioned a larger proportion of fruit held to the trees that were sprayed than held to the unsprayed trees. Branches of sprayed and of unsprayed fruit were exhibited at the World's Fair and Mr. Geo. T. Powell, superintendent of the horticultural exhibit of New York State, reports that when they were received a very large per cent of the unsprayed fruit had dropped from the branches, while but a very small per cent of the fruit had dropped from the branches that were sprayed.* All these things indicate very clearly that the foliage and fruit on the sprayed trees were in a much more healthy condition throughout the season than were the fruit and foliage of the unsprayed trees.

Pear scab and pear leaf blight.— Pear scab is the name commonly given to a disease which manifests itself on the fruit in dark olive green or brown spots followed in many cases by a roughness of the skin and cracking of the fruit. Figure 1, Plate VIII, is from a photograph of a scabby pear which has become cracked in this way.

Pears may also become cracked as a result of attacks of the fungus *Entomosporium maculatum*, Lev. which causes the pear leaf blight.† In this section the leaf blight, *Entomosporium*

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* Powell, Geo. T., in Proceedings Western New York Horticultural Society, Rochester, N. Y., 1894, p. 77.

† This is not the bacterial "fire blight" which affects the wood and blights entire branches.

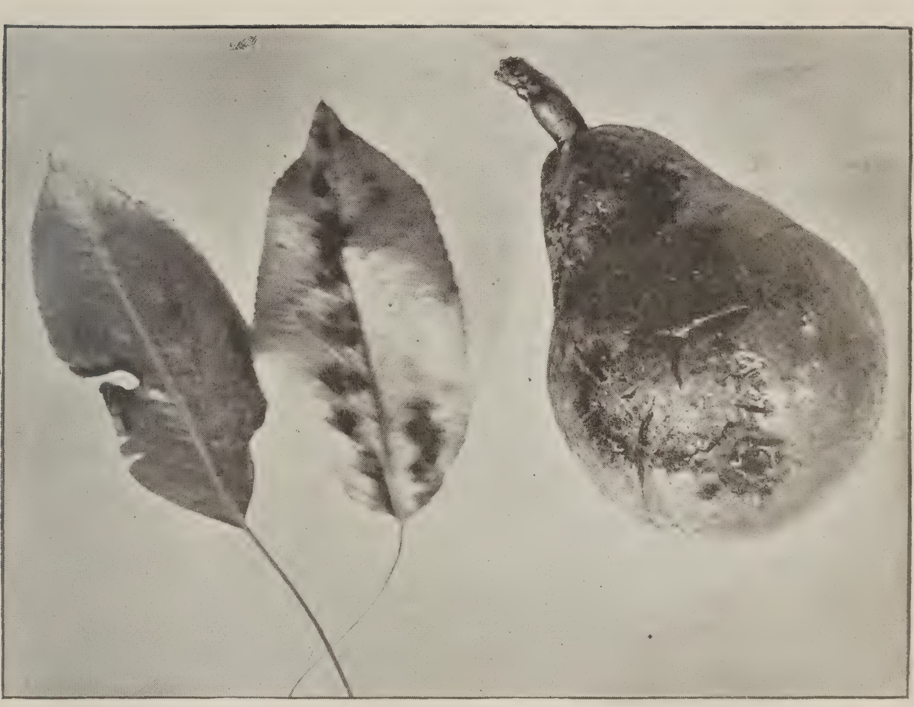

Plate VIII, Fig. 1.— From a photograph of White Doyenné showing the scab on fruit and on both the upper and the under surfaces of the foliage.

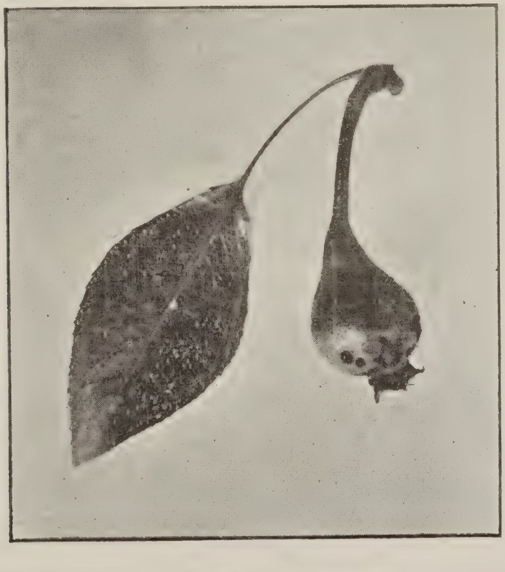

Plate VIII, Fig. 2.— From a photograph of a leaf and young fruit affected by the pear scab, *Fusicladium pyrinium*, (Lib.) Fckl.

seldom causes serious trouble in the orchards, though it is found to some extent, especially on certain varieties. It does much damage here by defoliating pear seedlings in the nursery. We have never seen fruit cracked by the leaf blight in New York State, but in States further south it attacks both the fruit and foliage, frequently doing much damage.

The distinction between pear scab and pear leaf blight should be kept clearly in mind, for the method of treatment which may properly be recommended for the leaf blight may not be sufficient for the disease known as pear scab.

Cause of pear scab.—Pear scab is caused by a parasitic fungus, *Fusicladium pyrinum* (Lib.), Fckl., which attacks both the leaves and the fruit. On the leaves it is usually found on the under surface, where it appears in spots as shown in Figure 1, Plate VIII, which is reproduced from a photograph. The same figure also illustrates the effect of the scab on the fruit and its appearance on the upper surface of a leaf.

Before the blossoms open the dark scab spots begin to appear on the tender new growth, thus showing, as previously stated, that infection takes place soon after the fruit buds open. Whether or not the fungus is in an active state of growth before the buds open is not at present known. The scab spots at first appear as a dark olive green or brown mold, with an almost velvety surface, bearing minute little bodies known as spores. The function of these spores will be readily understood if we say they are the seeds of the fungus, although strictly speaking they are too simple in structure to be called seeds. Under favorable conditions of moisture and temperature they readily germinate, and if they happen to be located on the foliage or fruit of the pear they soon send out a net-work of branching threads, absorb nourishment from the skin of the leaf or fruit and rapidly form a new scab spot, which in turn produces vast numbers of spores. Fig. 2, Plate VIII, reproduced from a photograph of a young fruit, shows that early in the season the fruit may be very much spotted by the disease. Scattered by the winds, the spores quickly spread the disease to other portions of the same tree and to other trees. Being very light, they easily float in the air and are quickly distributed over wide areas by the winds. Since each scab spot is capable of producing great numbers of the spores, it is seen at once that the disease may spread very rapidly under favorable circumstances. Damp locations and damp cool weather are generally considered most favorable to the spread of the disease.

On trees carefully sprayed early in the season the fungus has little chance to get a foothold, so that if spraying is begun soon after the fruit buds start to open, and continued until the middle or last of June, that is to say, three or four weeks after the fruit has set, the disease may be largely prevented.

It is clear that much more good may be accomplished by a timely early spraying than could possibly be secured by the same treatment later in the season, since the early spraying prevents the development of the disease in its incipient stages while the later spraying has to contend with the disease after it has become widely scattered and well established.

The scab continues to develop throughout the season whenever the weather conditions are favorable. This was noted this season especially with unsprayed White Doyennés on which the amount of scabby fruit increased to a marked degree between the first of July and the middle of September. Similar observations have been made by Jones, who found that the amount of scabby fruit on an unsprayed Flemish Beauty tree increased from fifty-five per cent July 6 to sixty-nine per cent July 28, and to seventy-two per cent August 31.*

Injury from spraying.— Greene † has found that, at least with some varieties, late spraying with the Bordeaux mixture causes a russet appearance on the fruit and therefore advocates but two treatments with this mixture after the fruit sets, making the second treatment about ten days after the blossoms fall. This difficulty was not noticed this season with either the White Doyennés or the Seckels sprayed three times after the blossoms fell, thus bringing the last spraying as late as June 28.

Number of sprayings.— Just how many sprayings will be found profitable in an ordinary season has not yet been definitely determined and further experiments on this point are desirable. No doubt the number of treatments and the strength of the mixture may well be varied according to the character of the season.

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*Bull. 28, Vermont Exp. Sta., 1892, p. 31.

† Bull. 48, Ohio Exp. Sta., 1893, p. 11, also proceedings of the Western New York Hort. Soc., 1894, p. 65.

Probably in very rainy seasons more frequent spraying with somewhat stronger mixture will be found profitable, while on the other hand, during long continued fair weather, a weaker mixture and less frequent sprayings would give practically as good results as a strong mixture frequently applied. It is doubtful whether the strength of this mixture may in any season be profitably reduced below that used in these experiments, namely, one pound of copper sulphate to about eleven gallons of the mixture.

Strength of Bordeaux mixture.— The Bordeaux mixture used at this station in the pear scab experiments of 1893 was made by dissolving four pounds of pulverized copper sulphate in from half to two-thirds of a barrel of cold water. The necessary amount of fresh slaked lime was then poured into the barrel in the form of a thin whitewash and the whole mixture diluted to forty-five gallons. The copper sulphate will dissolve more readily if it is suspended near the upper surface of the water. A basket or coarse sack may conveniently be used for this purpose. If the solution is wanted at once hot water may be used to dissolve the copper sulphate since it dissolves more quickly in hot water than in cold. It should never be dissolved in iron vessels. When the lime is poured into the solution care should be taken to keep out any coarse sediment that might clog the nozzle.

Weighing and straining the lime.— It was formerly thought necessary to strain the milk of lime into the copper sulphate solution and a coarse sieve or a gunny sack was commonly used for this purpose. It will be found, however, that the operation of straining is unnecessary if care is used in pouring. The clear lime water is not sufficient but the lime mixed with the water must be used.

The amount of lime necessary to form the Bordeaux mixture was formerly determined by weighing, using two-thirds as much lime as copper sulphate but by means of the potassium ferrocyanide test the necessity of weighing the lime is now obviated.

Potassium ferrocyanide test.— Pour the lime into the copper sulphate solution, stir the mixture thoroughly and then add a drop of the potassium ferrocyanide. If enough lime has been added the drop will not change color when it strikes the mixture, otherwise it will immediately change to a dark reddish brown color. More lime must then be added till the potassium ferrocyanide does not change color when dropped into the mixture.

The potassium ferrocyanide, also known as the yellow prussiate of potash, is a poisonous substance. It is a yellow salt which readily dissolves in water and a solution may conveniently be kept on hand in a small bottle. The commercial form of the potassium ferrocyanide may be used. A few cents should purchase enough to last through the season.

Excess of lime.— It is important that enough lime be added, otherwise the mixture may injure the foliage, while an excess of lime will not harm the foliage.

Use fresh Bordeaux mixture.— We prefer to use the fresh Bordeaux mixture because it becomes granulated after standing awhile and it seems to stick better to the foliage if applied fresh.

Fresh slacked lime It is best to use either fresh slaked lime, or lime kept in the condition described below, because it takes less of this to form the Bordeaux mixture than it does of air slaked lime, and because the mixture made with the fresh slaked lime sticks to the foliage better than that made with the air slaked lime. The lime may be slaked in large quantities if it is kept covered with water to exclude the air after the manner commonly practiced by masons. In this way the lime will keep for an indefinite period in satisfactory condition.

Stock solution of copper sulphate.— Some have made a practice of dissolving the copper sulphate in large quantities making a strong solution from which small portions are measured out as needed and diluted to the proper proportions required by the Bordeaux mixture formula. At first we were inclined to doubt the reliability of this method from the fact that some experience with saturated solutions indicated that portions taken from the bottom of a barrel of a stock solution would be stronger than equal portions taken from the top of the barrel. One gentleman who has followed this method for two years reports that the copper sulphate crystallized out of the solution forming crystals on the bottom and sides of the barrel in which the stock solution was kept. This shows that he has not been making the Bordeaux mixtures of uniform strength. The portion of the stock solution used after the crystals began to form must have been a saturated solution, and must have made a stronger Bordeaux mixture than that used before the crystals began to form.

A solution containing sixty-nine grams of copper sulphate per litre after standing in a corked bottle about ten weeks was tested and the top showed 1.0365 specific gravity, while the bottom showed 1.0550 specific gravity, making a difference of 0.0185 between the two. But a solution containing two pounds of copper sulphate per gallon after standing a week showed practically no difference between the top and bottom as to strength of the solution. It seems therefore that for all practical purposes a solution containing two pounds of copper sulphate per gallon may be safely used for stock solution.* It would take two gallons of such a solution to make forty-five gallons of the Bordeaux mixture according to the formula given on a previous page.

Spraying in rainy weather.—If Bordeaux mixture has time to dry after it is applied to the foliage it will take a good deal of rain to wash it all off. Ordinarily, when the proper time for spraying has arrived, it is best to do the work even though there are prospects of rain, for in many such instances either very little rain falls or perhaps none at all, and if the spraying is done the full benefit of the treatment is secured. In following this plan it occasionally becomes necessary to repeat the spraying after a heavy rainfall, but the time spent in such instances in making an extra spraying will be much less than the time wasted when the opposite course is pursued and the spraying postponed whenever the clouds threaten rain.

Nozzles.— In recent years many good nozzles for applying fungicides and insecticides have been devised, but it is generally conceded that for the application of Bordeaux mixture nothing has yet been found that equals the Vermorel. Various forms of this nozzle are on the market, some of which have no joint between the nozzle chamber and the elbow. Occasionally some obstruction lodges between the elbow and the nozzle chamber, and therefore it is best to select those forms of the Vermorel which have a joint at this place, so that the part containing the nozzle chamber may be easily separated from the rest of the nozzle and any obstruction removed.

The Vermorel nozzle is capable of giving an exceedingly fine spray, which is most desirable, but it can throw the spray but a few feet beyond the nozzle. Its best work is probably done at a distance of from two to four feet from the nozzle's orifice. It is readily seen that in treating very large trees this nozzle must in some way be lifted into the branches. Climbing the trees can not profitably be practiced to any great extent, so that for those parts of the tree which can not be reached by poles or "bamboo extensions," some other kind of nozzle is used capable of throwing a spray to a greater distance, although the spray be not so fine as that made by the Vermorel. For such long distance work we used the McGowen nozzle.

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* See *Solutions* by W. Ostwald, translated by Muir, 1891, "Homogeneousness of solutions," pp. 148 to 151.

Bamboo extension.—The bamboo extension has been in use for several years in spraying orchards. It consists of a three-eighths inch brass tube inside of a bamboo pole. To the lower end is attached a coupling by means of which it is joined to the discharge hose of the spray pump. A stop-cock at this end permits the operator to shut off the spray readily whenever he chooses to do so. To the other extremity of the bamboo extension the nozzle is attached. The extensions are usually from six to eight feet long, so that when the operator stands in a wagon he can with the Vermorel nozzle satisfactorily spray branches from fifteen to twenty feet from the ground.

In treating small orchards the hose may be fastened to a pole and thus the nozzle may be lifted up among the branches of tall trees, but where large orchards are to be treated it will probably be best to use the bamboo extension. Spraying is hard work even with the best appliances and the use of clumsy apparatus will not be economical in large orchards.

Force pumps.—For applying mixtures containing copper compounds the pumps should be of brass or brass lined, otherwise they will become corroded. In selecting a pump for use on an ordinary tank or barrel, it is best to get one with double discharge so that two leads of hose may be used when necessary. These in turn may be each fitted with a "Y" coupling thus dividing each stream into two and permitting the use of four nozzles.

Many good pumps are on the market and it would be difficult to say which is the best. In treating the pear orchard in 1893, the Nixon "Climax" and the Gould "Clock" pumps were used. Both do good work, but neither one was wholly satisfactory in treating the tallest trees because they were not powerful enough.

Agitators.—In applying either Bordeaux mixture or Paris green it is very necessary that the liquid be thoroughly stirred in order to insure uniform strength in the application, otherwise the copper compounds and the Paris green will settle to the bottom of the tank. Experience has shown that agitating by means of a hose returning a stream to the bottom of the tank is unsatisfactory. A wooden dash or paddle may be usually fitted to the pump so that with every stroke of the pump it will stir the mixture. When necessary, as for instance, after the tank has been standing still for a few minutes, this agitator may be supplemented by stirring the mixture thoroughly with a stick. Except with geared pumps the above method is the most satisfactory one that we know of at present.

Bordeaux mixture not a cure.—The fact that Bordeaux mixture, or any other fungicide, is not a cure for fungous attacks can not be too strongly emphasized. The Bordeaux mixture is sprayed on the foliage and fruit simply to prevent the germination there of the spores of the fungus by means of which the fungus is propagated. It is evident, therefore, that the Bordeaux mixture must be used as a preventive of, rather than as a cure for fungous attacks. For this reason the foliage and fruit should be kept covered with the Bordeaux mixture from the time when they first emerge from the bud till a month, at least, after the blossoms fall. *The success of the treatment depends in a large measure on the timely and thorough application of the mixture.*

Results of the experiments.—The results of these experiments certainly give an affirmative answer to the question whether or not dilute Bordeaux mixture, containing one pound of copper sulphate to about eleven gallons of the mixture may be used successfully against pear scab and show, at least under the conditions existing in this case, that it may safely be relied on if it is applied thoroughly and at the proper time. This conclusion confirms in a measure the results previously obtained by Galloway and Fairchild* and by Greene.†

Spraying early.—So far as this trial is concerned the results shown in Table XX, p. 698, answer the question whether or not three sprayings after the fruit buds begin to open and before the blossoms open are better than two sprayings during the same period. It will be noticed that the highest prices both for sprayed and unsprayed fruit were obtained for the pears grown in that part of the orchard where the Seckels were sprayed five times. This may be partially accounted for by the fact, noted frequently during the season, that the attacks of the scab were not so severe on the unsprayed trees in this part of the orchard as they were in that portion where the Seckels were sprayed six times, so that the two methods of treatment are not in this case strictly comparable. Comparing the gain per hundred trees computed from the highest prices received for the sprayed fruit it is seen that with trees sprayed six times the gain is $577 while with the trees sprayed five times the gain is $566, making an increase of eleven dollars apparently due to the extra spraying. This increase would more than pay for the cost of the extra spraying, but it is doubtful whether the extra spraying should be credited with this gain, and the indications are that it should not. A heavy rain storm followed the first spraying and it is possible that the effect of the first treatment was consequently much less than it would have been had the weather remained fair. On the whole it may still be considered doubtful whether it is expedient to spray more than twice after the fruit buds begin to open and before the blossoms open.

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* Jour. Myc., VI, pp. 137–142; Rep. U. S. Dept. Agr. 1890, pp. 397–8, and Bull. No. 3, 1892 (Experiments of 1891), U. S. Div. Veg. Path. pp. 36–47.

† Bull. 9, Vol. IV, Ohio Expt. Sta., 1891, pp. 212–213, and Bull. 48 of the same station, 1893, pp. 11–12.

In conclusion it may be said that both the Seckel and the White Doyenné pears are varieties especially subject to the attacks of the scab fungus and, therefore, as previously stated, the large gains resulting from their treatment, as shown in these experiments could not be expected to result from spraying every other variety. Yet the fact remains that the fruit and foliage of many of the varieties grown in New York State pear orchards suffer considerable damage each year from the fungous diseases which may be successfully treated by spraying with the Bordeaux mixture and also from insect foes that may be treated at the same time with Paris green. It is undoubtedly true that tens of thousands of dollars might be saved annually to the New York pear growers by the universal adoption of the method of treatment which is here shown to be very successful in preventing the depredations of some of the worst insect and fungous enemies of the pear.

SUMMARY.

1. In these experiments, pear scab was successfully treated by dilute Bordeaux mixture containing four pounds of copper sulphate to forty-five gallons of the mixture.

2. Comparing three treatments after the buds begin to open and before the blossoms open with two treatments during the same period, it is still doubtful whether enough benefit may be gained from the former to justify the expense of the extra treatment.

3. In order to treat pear scab successfully, the spraying must be done thoroughly and at the right season.

4. The benefits of the treatment extend to the tree as well as the fruit, as shown by the increased vigor of the foliage and fruit on the sprayed trees when compared with the unsprayed trees.

BIBLIOGRAPHY.

A few reference to articles on pear scab and its treatment are given below.

1. [ANON.] *Notes of Meeting of Western N. Y. Hort. Society*, 1890. **Garden and Forest**, Vol. III, p. 60. States that hyposulphite of soda, though not a perfect remedy for pear scab, is the best one known at present.

2. [ANON.] *Scabby pears.* **Country Gentleman**, Albany, N. Y., 1892, Vol. LVII, p. 47. Says spraying with copper solution has been tried without definite results.

3. ARTHUR, J. C. **Report New York State Experiment Station**, Geneva, N. Y., 1884, pp. 367–368. Describes the general appearance of, and damage caused by pear scab. Mentions fungicides which have been suggested by Burrill and by Saunders.

4. BAILEY, L. H. **Bull. XIX, Cornell Experiment Station**, Ithaca, N. Y., 1890, p. 49. States that *F. pyrinum* has probably caused much of the failure in the pear crop this year. On p. 52 states that the scab is abundant this season on the fruits.

5. BEACH, S. A. **Report of the proceedings of the Western N. Y. Hort. Soc.**, Rochester, N. Y., 1893, pp. 14–20. The report of committee on plant diseases notes the prevalence of the pear scab during 1892 in western New York, showing that it caused considerable damage to the crop.

6. BURRILL, T. J. **Transactions Miss. Valley Hort. Soc.** 1883, I, p. 202. Recommends kerosene emulsions as fungicides for this disease.

7. CHESTER, F. D. **Bull. III. Del. Exp. Station,** 1888, pp. 4–5. Recommends spraying once, or more, with Bordeaux mixture containing six pounds of copper sulphate to twenty-two gallons of the mixture.

8. ———. *Spraying with potassium sulphide for pear scab.* **Bull. No. 8, Del. Exp. Station,** 1890, pp. 11–14. Notes that different varieties are affected in different degrees by the scab. Finds that treatment with potassium sulphide is of some benefit. Notes that one of the largest pear orchards in the State, located near Newark, has for a long time been infested with the pear scab. See also Expt. Station Record, 1890, Vol. II, p. 49.

9. ———. —————. **Annual Report Del. Exp. Station,** 1889, pp. 88 to 91. A reprint of the article in Bulletin No. 8, above mentioned.

10. CHURCHILL, G. W. **Bull. 35, N. Y. State Exp. Station,** Geneva, N. Y., 1890. Gives appearance of pear scab on leaves and fruit. Proposes remedies and gives formulæ for same.

11. ———. **Report N. Y. State Exp. Station,** 1890, pp. 337–338. A reprint of the article in bulletin 35, above mentioned.

12. COBB, N. A. **Agr. Gaz. N. S. Wales,** 1891, Vol. II, pp. 60–62. Recommends ammonia-carbonate treatment.

13. COOKE, M. C. **Grevillea,** Vol. XII, p. 11. *F. pyrinum* is listed from Australia.

14. EARLE, F. S. **Trans. Ill. Hort. Soc'y,** 1886, pp. 170–171. Gives popular discussion of pear scab, notes its distribution from California to the Atlantic coast and in Europe. States that no remedies thus far proposed have been demonstrated to have practical value.

15. ERIKSSON, JOKOB. **Botanisches Centralblatt,** XXVI, 1886, pp. 347–348. In a review of Eriksson's **Bidrag till kannedomen om vara odlade vaxters sjukdomar** (Contribution to the knowledge of the diseases of our cultivated plants), Samson & Wallin, Stockholm, Sweden, 1885, it is stated that at Stockholm the pear scab is less prevalent than the apple scab, but, whenever it does occur, it causes more injury than the apple scab. It was found

in the summer of 1884 both on leaves and twigs of the Napoleon pear, and was seen on both sides of the leaves. At Rosendale it was especially injurious to the Jacob and Larsmesse varieties and less injurious to the Duchesse d' Angoulème, Ulriksdals, Sylt and Kanel varieties.

It is also stated that the occurrence of the fungus on the leaf was first noticed by Libert in France as *Helminthosporium Pyrorum* and was described in 1840 by J. Desmazieres, who afterwards identified it with Wallroth's *Cladosporium dendriticum.* Undoubtedly the same fungus is included by H. T. Bonorden in his *Abbildung*, Tafel IV, fig. 94. Henceforth the apple-scab fungus and the pear-scab fungus were included in one species until L. Fuckel, in 1869, separated them as distinct species. He called the pear-scab fungus *F. pyrinum.*

The fungus on the pear fruit was first noticed by J. Peyl in Bohemia in 1864 as *Cladosporium polymorphum.* P. Sorauer described it more fully in a communication on this subject to the Society of Natural Sciences in Breslau. E. Prillieux presented the same subject before the French Academy in Paris, November 12, 1877, and also before the French Botanical Society, January 25, 1878.

Like the apple-scab fungus, the pear-scab fungus sends its mycelium only among the superficial cells of the affected plant tissue. The conidiaphores are knotted in certain places and the conidia are pointed at both ends. The conidia germinate readily in water. The only preventive measure suggested consists in not propagating from the wood of diseased trees.

16. Evans, W. H. **Handbook of Experiment Station Work,** U. S. Office of Experiment Stations, Washington, D. C., 1893, p. 245, states that it requires the same preventive treatment as apple scab, namely (p. 18): Bordeaux mixture, ammoniacal carbonate of copper, or modified eau celeste, after the leaves come out, and copper sulphate solution, one pound to ten gallons of water, before the leaves appear. Average cost need not exceed thirty to forty cents per tree.

17. Fairchild, D. G. See Galloway and Fairchild, No. 23, and Rusk, J. M., No. 41.

18. Farlow, W. G. **Provisional Host Index of Fungi of the United States,** p. 40. Gives the following synonyms of *Fusi*

cladium pyrinum, Fckl., namely, *Helminthosporium Pirorum* Lib., *Cladosporium dendriticum* (Wallr.), Fckl; *Fusicladium dendriticum*, Fckl.

19. FRANK, A. B. **Die Krankheiten der Pflanzen**, 1880, p. 589. Considers the pear-scab fungus *Fusicladium pyrinum* (Lib.) Fckl. as distinct from the apple scab fungus, *F. dendriticum* (Wallr.) Fckl. States that it occurs on the one-year old twigs as well as on both sides of the leaves and on the fruit. Notes that the infected leaves fall somewhat sooner than do the healthy leaves.

20. GALLOWAY, B. T. **Bull. No. 3, U. S. Div. Veg. Pathology**, 1892, pp. 36-47. Reports results of experiments made in 1891. Copper saccharate and glue mixture gave best results for pear scab alone. Bordeaux mixture gave best results for both pear leaf blight and pear scab.

21. ———. **Jour. Mycology, VI**, p. 14. States that pear scab is especially prevalent in New Jersey, Delaware and adjoining states. Recommends treatment with Bordeaux mixture both for large trees and for seedlings.

22. ———. **Farmer's Bulletin, No. 7, U. S. Dept. Agr.**, 1892, p. 15. Outlines method of treating both pear scab and pear leaf blight by one line of treatment with Bordeaux mixture.

23. GALLOWAY, B. T., and FAIRCHILD, D. G. **Rep. U. S. Dept. Agr.**, 1892, pp. 397-398. Report result of testing relative values of Bordeaux mixture, ammoniacal solution of copper carbonate, copper acetate, copper carbonate in suspension and mixture No. 5. The experiments were also conducted with a view of determining the best number of treatments, the best time to make the applications and the cost of treatment. Conclude that:

1. Early treatments (beginning before the fruit is half an inch in diameter) are necessary to prevent the scab.

2. Spraying after the fruit is half grown is liable to injure its appearance.

3. Best results were obtained with Bordeaux mixture and the ammoniacal solution of copper carbonate.

24. ——— ———. **Journal Mycology VI**, pp. 137–142. Give details of the experiments noted above. See No. 23.

25. GREEN, W. T. **Ohio Exp. Station, Bul. 9, VI**, 1891, pp. 212–213. Finds that sprayed fruit keeps better after being picked than does unsprayed fruit. Notes the beneficial effect of spray-

ing on the foliage. Foliage was injured by treating with modified eau celeste, and also by "ammonia copper" solution. Prefers dilute Bordeaux mixture containing six pounds of copper sulphate to forty-four gallons of the mixture.

26. ———. **Bul. 48, Ohio Exp. Station,** 1893, pp. 11–12. States that a russeting or roughness of the skin of the fruit occurs when Bordeaux mixture is used more than twice after the blossoms fall, so that he makes the last spraying about ten days after the blossoms fall.

27. GOFF, E. S. **Report N. Y. State Exp. Station,** Geneva, N. Y., 1886, pp. 173–174 [or 177–178]. Experimented with sodium hyposulphite as a fungicide for pear scab using one pound to ten gallons of water and one pound to twenty gallons of water. Thought some slight benefit resulted from the treatment.

28. ———. **Bul. 34, Wis. Exp. Station,** 1893, p. 7. Recommends spraying with Bordeaux mixture.

29. HOOKER, C. M. **Proceedings Western N. Y. Hort. Soc'y,** 1888, pp. 30–31. Has observed the scab attacks for several years and has noticed that when dry winds occur at blossoming time little scab is seen during the following season, but when damp weather occurs at blossoming time the scab is prevalent the following season.

30. ———. **Proc. West. N. Y. Hort. Soc'y,** 1891, pp. 57–60. Speaking of the pear crop of Monroe county in 1890, states that many varieties set a good crop of fruit but immediately after the falling of the blossoms the scab fungus developed in remarkable abundance, both on the leaves and on the fruit, either causing the fruit to drop or rendering it worthless. Though the pear suffered less than the apple very little first-class pear fruit was found. Discusses also the nature of the fungus attack and the advisability of spraying as a preventive of such attacks. Compare with No. 4 above.

31. JONES, L. R. **Report Vermont Exp. Station,** 1890, p. 142. Notes that pear scab is especially troublesome on Flemish Beauty.

32. ———. **Report Vermont Exp. Station,** 1891, p. 132. Summarizes the results published in Bul. 28. See No. 33.

33. ———. **Bul. 28, Vermont Exp. Station,** 1892, pp. 30–34. In an experiment with two trees one was sprayed and the other

left unsprayed for comparison and it was found that ammmoniacal solution of copper carbonate was effective as a fungicide. On unsprayed Flemish Beauty tree noted that the amount of scabby fruit increased from fifty-five per cent July 6 to seventy-two per cent August 31.

34. ———. **Report Vermont Exp. Station,** 1892. p. 25. States that pear scab may be largely prevented by spraying with copper solutions.

35. ———. **Newspaper Bulletin No. 2, Vermont Exp. Station.** Mentions proposed treatment of pear scab for 1893 with copper carbonate.

36. LAMSON, H. H. **Report New Hampshire Exp. Station,** 1890 and 1891, pp. 216–241. Bordeaux mixture and ammoniacal solution of copper carbonate were tested and five treatments made with each. The reduced amount of cracked and scabby fruit demonstrated the value of the treatment. See also Exp. Station Record, V, p. 60.

37. LUDWIG. **Die niederen Kryptogamen,** p. 316.

38. MAGNUS, P. **Verzeichnis der vom 11 August bis 10 September 1891 bei Bad Kissingen in Bayern gesammelten meist parasitischen Pilze,** p. 6. Notes the occurrence of *F. pyrinum* on fruit and leaves of pear in a garden.

39. MASSEY, W. F. **Bul. 92, N. C. Exp. Station,** p. 98. Gives brief note on pear scab with illustration of scabby fruit. Recommends treatment with copper sucrate.

40. PRILLIEUX. **Comptes rendus,** 1877, p. 910. Observed the pear scab in Paris, France. Thought it could be carried over winter on the young twigs. Cited by Frank in *Die Krankheiten der Pflanzen* p. 589.

41. RUSK, J. M. **Report of U. S. Sec'y of Agriculture,** 1892, p. 47. Mentions Fairchild's discovery at the N. Y. State Exp. Station, Geneva, N. Y., of the appearance of the pear scab fungus on the unopened flower buds, " a fact long suspected but never before demonstrated."

42. SAUNDERS, WM. **Canadian Horticulturist,** VII, p. 127. As fungicides for pear scabs suggests (1) hyposulphite of soda, (2) sulphide of lime, or (3) sulphur in suspension.

43. ———. **Proceedings Western N. Y. Hort. Soc'y,** 1891, p. 60. Recommends burning sulphur in packing shed before bar-

reling the fruit to prevent the growth of the scab after the fruit is barreled.

44. Scribner, F. L. **Fungous diseases of the grape and other plants**, 1890, chap. XIV. Considers the pear scab fungus as identical with *F. dendriticum* (Wal.) Fckl.

45. ———. *Pear Scab*, **Orchard and garden**, XII, 1890, pp. 143–144. Shows necessity of early spraying. Recommends treatment with iron sulphate or copper sulphate in April before the buds start, afterwards spraying with modified eau celeste or ammoniacal solution of copper carbonate.

46. Sorauer, P. **Pflanzenkrankheiten**, pp. 8 and 372.

47. Stiles, W. A. **Garden and Forest**, VII, pp. 49 and 60. Gives abstract of paper by S. A. Beach before the meeting of the Western N. Y. Hort. Society, Rochester, N. Y., Jan. 24, 1894, giving results of experiments which are treated fully in preceding pages of this report.

48. Sturgis, W. C. **Bul. III, Conn. Exp. Station, New Haven, Conn.**, 1892. Thinks Bordeaux mixture or ammoniacal solution of copper carbonate would be more effective against pear scab than would sulphide of potassium. Recommends beginning treatment when the flowers are opening.

49. ———. **Bul. 115, Conn. Exp. Station**, 1893, p. 5. Outlines method of treatment with Bordeaux mixture.

50. Thaxter, R. **Report Conn. Exp. Station**, 1893, p. 173. Notes that pear scab has been locally very injurious.

51. Thomas, J. J. *Culture of Standard Pears.* **Proc. Western N. Y. Hort. Soc'y**, 1888, pp. 20–21. Notes that the Flemish Beauty and [*Virgalieu*] White Doyenné which for many years past have been spoiled by scab and cracking were fair the past season. In previous reports of this society Mr. Thomas has also called attention to Seckel trees which formerly produced good fruit, but in several recent years the fruit has been much injured by the scab.

52. Thumen, Felix von. **Fungi Pomicola**, 1879, p. 15. Considers the scab fungus of pear identical with the scab fungus of apple and describes it under the name of Fusicladium dendriticum.

53. Winter, Dr. Geo. **Hedwigia**, XIV, p. 35. Treats of the synonomy of this and other forms which he considers the same.

METEOROLOGY FOR 1893.*

The record of all the wind strong enough to turn a vane has been recorded accurately as to direction and time. The record of sunshine has been continued uniform with the first record adopted by Dr. Babcock, and a summary follows the record for 1893, showing a comparison of the sunshine for each year it has been recorded by the Neggretti and Zambra instrument.

The different tables follow in their order.

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*R. D. Newton in charge.

PRECIPITATION BY MONTHS SINCE 1882.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
1882	....	....	....	....	....	3.69	2.42	2.37	1.25	0.62	1.22	0.55	....
1883	0.48	1.44	0.88	1.58	4.45	4.12	2.98	3.47	2.12	2.10	1.54	0.73	25.89
1884	1.83	2.01	2.54	0.83	2.49	2.01	2.33	1.44	3.17	1.67	1.01	0.97	22.30
1885	1.07	0.61	0.12	1.26	1.58	2.49	4.64	5.02	2.11	2.88	1.36	0.76	23.90
1886	1.13	0.95	1.13	4.13	1.92	2.92	4.41	2.86	2.31	1.39	3.48	1.24	27.87
1887	0.18	2.97	0.48	1.37	0.46	2.01	6.37	3.03	0.75	1.74	1.58	1.35	22.29
1888	0.78	1.04	1.43	3.09	2.79	3.88	0.99+	4.02	2.73	3.47	2.02	1.24+	27.48
1889	2.99+	0.25	0.66+	3.28	1.21	7.47	4.57	1.98	2.50	3.32	3.44	1.62	32.28
1890	2.16	1.45	2.16	2.20	5.49	5.26	1.07	4.34	5.81	4.54	2.40	....	36.88
1891	1.44	1.57	3.25	1.63	0.49	4.31	3.52	3.16	0.47	2.65	0.74	3.29	27.52
1892	0.57	0.88	0.55	0.67	4.04	3.95	1.89	4.77	1.12	1.34	2.67	0.72	23.17
1893	1.62	3.71	1.94	2.59	4.92	3.08	3.68	5.38	2.68	1.59	1.09	1.56	33.84

WIND RECORD FOR 1893.

DATE.	JANUARY.				FEBRUARY.				MARCH.				APRIL.			
	Northerly, N. W. to N. E.	Easterly, N. E to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.
	Hrs.	Hrs.	Hrs	Hrs	Hrs.	Hrs.	Hrs.	Hrs.	Hrs	Hrs	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1			10.0			5.0	9.0				9.0	11.0			14.0	4.0
2			12.0	11.0	18.0							21.0	5.0			18.0
3				24.0		2.0	8.0				18.0	20.0	1.0	1.0	10.0	3.0
4				13.0				10.0	19.0						8.0	4.0
5			3.0	4.0				18.0			7.0	10.0	8.0	4.0	2.0	10.0
6			6.0	8.0				15.0			6.0	5.0	1.0	1.0	10.0	
7				24.0			20.0				9.0		4.0	1.0	4.0	7.0
8				12.0				17.0		2.0	4.0		3.0		3.0	18.0
9			8.0	6.0			23.0		7.0			2.0		1.0		2.0
10				20.0			24.0				16.0			5.0		
11				23.0			14.0				15.0	6.0			19.0	
12		8.0		7.0			19.0					20.0			23.0	1.0
13	7.0			6.0			17.0				10.0					11.0
14		2.0	8.0	11.0	4.0	7.0	4.0				2.0	20.0	1.0		8.0	2.0
15	8.0			7.0	4.0	7.0	1.0					19.0				23.0
16	11.0			8.0			12.0	7.0		3.0	2.0	14.0			5.0	
17	6.0		10.0		2.0	1.0		17.0	10.0		4.0					22.0
18			14.0		2.0	8.0		12.0	6.0		2.0			4.0		10.0
19				17.0	5.0	5.0	1.0	6 0			14.0		2.0	8.0	4.0	
20			8.0	9.0		7.0		17.0			15.0	3.0			20.0	3.0
21			6.0	8.0				23.0				8.0		6.0	3.0	11.0
22			16.0		4.0			13.0			6.0					24.0
23			8.0	4.0	6.0	6.0		2.0			24.0				2.0	20.0
24				18 0		8.0	4.0	2.0			6.0	16.0	9.0		5.0	
25			16.0	3.0		2.0	4.0	10.0				5.0	7.0	3.0	6.0	
26	12.0				6.0	1.0		10.0		2.0		3.0			24.0	
27		11.0		6.0		2.0	8.0	9.0	8.0	4.0		3.0			4.0	12.0
28			8.0	13.0	4.0		11.0	8.0	8.0		2.0			2.0		7.0
29			24.							9.0	11.0	3.0	3.0	6.0		
30				19.0					6.0			17.0		4.0	2.0	3.0
31		2.0	6.0	3.0												
Total hours of movement	44.0	23.0	163.0	284.0	55.0	61.0	179.0	196.0	54.0	21.0	182 0	206.0	44.0	46.0	176.0	215.0
Per cent. of time in each direction	8.6	4.5	31.7	55.2	11.2	12.4	36.5	39.9	11.7	4.5	39.3	44.5	9.1	9.6	36.6	44.7

WIND RECORD — (*Continued*).

DATE.	MAY.				JUNE.				JULY.				AUGUST.			
	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S E. to S. W.	Westerly, S. W. to N. W.
	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1			12.0			4.0	15.0		3.0	1.0			2.0	4.0		1.0
2			14.0	8.0			22.0				6.0		8.0			3.0
3	2.0			11.0			24.0				6.0	3.0	3.0			
4	17.0						21.0	2.0	6.0		2.0	16.0	1.0		5.0	2.0
5				24.0			2.0	9.0			6.0	5.0			6.0	
6				24.0		4.0		2.0			2.0	15.0	3.0		2.0	2.0
7	4.0			20.0				19.0			5.0	3.0				24.0
8			4.0				2.0	6.0			10.0	2.0	6.0			4.0
9		4.0					9.0	1.0				22.0	3.0		1.0	
10		3.0	2.0	3.0			3.0	5.0	6.0			12.0		4.0	3.0	
11			8 0				3.0	4.0	5.0			3.0		1.0	6.0	
12		5.0	13.0	2.0				13.0	2.0		2.0	3.0		1.0	4.0	8.0
13			7.0	3 0	7.0		4.0		2.0		2.0	2 0	6.0			8.0
14		4.0	4.0	4.0			8.0		2.0		1 0		5.0		2.0	1.0
15			5.0	8.0			4.0	6.00		6.0	2.0		6.0	1.0		1.0
16	1.0	4.0	9.0			2.0	9.0			4.0	1.0	10.0	4.0	1.0		3.0
17			19.0	1.0			6.0		2.8			5.0	2.0			4 0
18				20.0				9.0		2.0	1.0	2.0		3.0	6.0	2.0
19	8.0			15.0				8.0	8.8	1.0		8.0		6.0		
20	7.0		5.0		13.0				9.0				4.0	2.0		3.0
21			4.0	16.0	4.0			6.0	2.0	2.0		4.0	4.0	2.0	2.0	
22			4.0	10.0			5.0	4.0		2.0		17.0	4.0			3.0
23		5.0	12.0				1.0	19.0		2.0		14.0	7.0			5.0
24			3.0	21.0	4.0			2.0	9.0			6.0		3.0	11.0	1.0
25			9.0	6.0		1.0		12.0			7.0	7.0	4.0	1.0	12.0	
26		5.0		13.0		2.0	2.0	8.0		1.0		20.0				9.0
27			4,0		3.0		13.0			2.0		14.0				14.0
28			5.0	18.0			11.0		5.0		3.0	8.0	2.0		3.0	
29			2.0	6.0			4.0			3.0	16.0	3.0			7.0	3.0
30		4.0		1.0		2.0	4.0			2.0		14.0	5.0	10.0	3.0	2.0
31		1.0		5.0					6.0			2.0				24.0
Total hours of movement	39.0	35.0	145.0	239 0	31.0	15.0	172.0	135.0	67.0	28.0	72.0	220.0	79.0	39.0	73.0	127.0
Per cent. of time in each direction	8.5	7.6	31.7	52.2	8.8	4.2	48.7	38.3	17.3	7.3	18.6	56.8	24.8	12.3	23.0	39.9

WIND RECORD — (*Concluded*).

DATE.	SEPTEMBER.				OCTOBER.				NOVEMBER.				DECEMBER.			
	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. F. to S. E.	Southerly, S. E. to S W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.
	Hrs	Hrs.	Hrs.	Hrs.	Hrs	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.	Hrs.
1	....	....	8.0	4.0	13.0	....	....	....	....	....	22.0	....	....	....	....	18.0
2	....	....	12.0	10.0	5.0	....	....	17.0	....	6.0	18.0	....	....	....	....	24.0
3	....	....	....	8.0	2.0	....	4.0	....	....	....	13.0	....	....	2.0	14.0	2.0
4	....	2 0	....	8.0	....	....	21.0	....	....	....	....	5.0	....	....	2.0	21.0
5	....	....	....	2.0	....	2.0	2.0	....	5.0	....	6.0	....	1.0	....	8.0	2.0
6	8.0	4.0	....	2 0	....	2.0	7.0	....	....	....	6.0	5.0	2.0	2.0	13.0	2.0
7	3.0	....	9.0	2.0	....	1.0	18 0	5.0	3.0	2.0	....	....	....	....	4.0	11.0
8	2.0	5.0	2.0	5.0	....	1.0	4.0	7.0	....	....	18.0	....	....	....	24.0	....
9	....	5.0	4.0	2.0	....	....	4.0	8.0	....	....	3.0	5.0	....	....	13.0	11.0
10	2.0	....	11.0	....	3.0	....	....	15.0	....	....	....	6.0	2.0	....	....	17.0
11	3.0	....	6.0	....	3.0	2.0	4.0	2.0	....	2.0	4.0	....	....	2.0	14.0	....
12	....	....	17.0	....	....	....	9.0	....	....	2.0	8.0	....	....	8.0	7.0	....
13	2.0	2 0	18.0	2 0	....	6.0	18.0	....	....	....	9.0	2.0	5.0	....	....	15.0
14	....	....	24.0	....	....	14.0	8.0	....	....	2 0	3.0	15.0	....	....	6.0	10.0
15	....	....	22.0	1.0	....	....	....	24.0	....	....	....	21.0	....	2.0	20.0	....
16	....	....	....	24.0	....	....	....	24.0	....	....	....	24.0	....	....	22.0	1.0
17	....	....	8.0	....	....	....	10.0	5.0	....	....	8.0	13.0	....	....	....	22.0
18	....	....	....	11.0	....	....	....	11.0	....	....	2.0	18.0	....	3.0	1.0	13.0
19	....	....	4.0	12.0	6.0	....	9.0	....	....	....	....	16.0	....	....	4.0	7.0
20	....	2.0	....	17.0	....	2.0	22.0	....	....	....	....	23.0	....	....	4.0	11.0
21	....	....	16.0	1.0	....	....	20.0	....	2.0	3.0	5.0	4.0	....	....	....	8.0
22	....	1.0	....	14.0	....	2.0	4.0	....	....	2.0	22.0	....	....	....	2.0	7.0
23	....	2.0	4.0	1.0	....	....	11.0	....	....	....	1.0	21.0	....	....	12.0	8.0
24	....	3.0	5.0	3.0	....	4.0	7.0	....	....	....	....	24.0	3.0	....	2.0	10.0
25	....	....	....	17.0	....	....	....	20.0	....	....	....	18.0	....	4.0	12.0	....
26	....	1.0	8.0	....	5.0	1.0	2.0	1.0	....	....	....	17.0	....	....	17.0	....
27	....	....	....	3.0	....	....	22.0	1.0	1.0	3.0	18.0	....	....	4.0	2.0	13.0
28	2.0	....	2.0	16.0	....	....	....	13.0	....	....	17.0	....	3.0	....	8.0	12.0
29	....	1.0	....	10.0	....	....	....	24.0	1.0	....	6.0	17.0	....	....	....	17.9
30	9.0	....	....	3.0	....	....	....	24.0	1.0	3.0	3.0	13.0	7.0	2.0	....	14.0
31	....	....	....	....	....	....	2.0	4.0	....	....	....	....	5.0	3.0	....	....
Total hours of movement	31.0	28.0	180.0	178 0	37.0	37.0	208.0	205.0	13.0	25.0	192.0	267.0	28.0	32 0	211.0	276.0
Per cent. of time in each direction	7.4	6.7	43.2	42.7	7.6	7.6	42.7	42.1	2.6	5.0	38.7	53.7	5.1	5.9	38.6	50.4

SUMMARY OF DIRECTION OF WIND FOR 1893.

	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.
January	44	23	163	284
February	55	61	179	196
March	54	21	182	206
April	44	46	176	215
May	39	35	145	239
June	31	15	172	135
July	67	28	72	220
August	79	39	73	127
September	31	28	180	178
October	37	37	208	205
November	13	25	192	267
December	28	32	211	276
Total hours of movement	522	390	1,953	2,548
Per cent. of time in each direction	9.6	7.2	36.1	47.1

SUNSHINE RECORD FOR 1893 BY NEGGRETTI AND ZAMBRA INSTRUMENTS.

DATE.	JANUARY.												FEBRUARY.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1.	0	00	0	00	0	00	0	00	0	00	9	08	0	00	0	00	0	00	0	00	0	00	10	00
2.	0	00	0	00	0	00	0	00	0	00	9	09	0	00	0	00	0	00	0	00	0	00	10	04
3.	0	00	2	30	3	00	0	15	5	45	9	10	0	00	1	30	2	00	1	00	4	30	10	04
4.	0	00	0	00	0	00	0	00	0	00	9	11	0	00	0	00	0	00	0	00	0	00	10	07
5.	0	00	0	00	0	00	0	00	0	00	9	12	0	00	1	00	2	00	0	00	3	00	10	09
6.	0	00	0	00	0	00	0	00	0	00	9	14	0	00	0	00	0	00	0	00	0	00	10	12
7.	0	00	0	00	1	10	0	00	1	10	9	15	0	00	0	00	0	00	0	00	0	00	10	14
8.	0	00	2	00	1	30	0	00	3	30	9	16	0	30	3	00	3	00	0	40	7	10	10	17
9.	0	00	0	00	0	00	0	00	0	00	9	17	0	00	3	00	1	00	0	00	4	00	10	19
10.	0	00	0	00	1	00	0	00	1	00	9	18	0	40	0	30	0	00	0	00	1	10	10	21
11.	0	00	1	20	0	00	0	00	1	20	9	19	0	00	1	00	1	15	0	00	2	15	10	24
12.	0	00	0	00	0	00	0	00	0	00	9	22	0	00	0	00	0	00	0	00	0	00	10	27
13.	0	00	0	00	1	30	0	00	1	30	9	23	0	00	0	00	0	00	0	00	0	00	10	29
14.	0	00	3	00	3	00	1	00	7	00	9	24	0	00	0	00	0	00	0	00	0	00	10	31
15.	0	00	1	00	2	10	0	00	3	10	9	26	0	00	0	00	0	00	0	00	0	00	10	35
16.	0	00	2	00	1	40	0	00	3	40	9	27	0	00	0	00	0	00	0	00	0	00	10	37
17.	0	00	0	40	2	00	0	00	2	40	9	29	0	00	0	00	0	00	0	00	0	00	10	41
18.	0	00	2	10	1	45	0	00	3	55	9	30	0	00	0	00	0	00	0	00	0	00	10	43
19.	0	00	1	50	2	00	0	50	4	40	9	33	0	00	0	00	0	00	0	00	0	00	10	46
20.	0	00	2	00	0	40	0	00	2	40	9	35	0	00	0	00	0	00	0	00	0	00	10	49
21.	0	00	1	20	2	00	1	00	4	20	9	36	0	00	0	00	0	00	0	00	0	00	10	52
22.	0	00	0	00	0	00	0	00	0	00	9	38	0	00	0	00	0	00	0	00	0	00	10	55
23.	0	00	0	00	0	00	0	00	0	00	9	41	0	00	0	00	0	00	0	00	0	00	10	58
24.	0	00	0	00	0	00	0	00	0	00	9	42	0	00	1	00	0	30	0	00	1	30	11	01
25.	0	00	0	00	0	00	0	00	0	00	9	44	0	00	1	30	2	00	1	00	4	30	11	04
26.	0	00	0	00	1	00	0	00	1	00	9	46	0	50	3	00	3	00	1	40	8	30	11	06
27.	0	00	1	00	0	00	0	00	1	00	9	49	0	45	3	00	3	00	1	50	8	35	11	10
28.	0	00	0	00	0	00	0	00	0	00	9	51	0	00	2	00	2	10	0	40	4	50	11	12
29.	0	00	0	00	0	00	0	00	0	00	9	53	....		....		....		....		....		....	
30.	0	00	2	00	1	00	1	00	4	00	9	56	....		....		....		....		....		....	
31.	0	35	3	00	2	00	1	00	6	35	9	58	....		....		....		....		....		....	
Total hours	0	35	25	50	27	25	5	05	58	55	294	12	2	45	20	30	19	55	6	50	50	00	296	05
Per cent. of possible	1.2		27.8		29.5		8.6		20.0		....		4.8		24.4		23.7		9.7		16.9		....	

SUNSHINE RECORD—(*Continued*).

DATE.	MARCH.												APRIL.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours sunrise to sunset.		Before 9 A. M.		9 to 12.		12		After 3 P. M.		Total hours.		Hours sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	1	00	3	00	3	00	1	40	8	40	11	15	0	00	0	00	1	10	0	00	1	10	12	41
2	0	00	0	00	0	00	0	00	0	00	11	17	0	00	0	00	2	45	0	45	3	30	12	42
3	0	00	2	00	1	00	0	00	3	00	11	20	1	00	2	00	0	00	0	00	3	00	12	46
4	0	00	0	00	0	00	0	00	0	00	11	23	1	30	3	00	3	00	1	50	9	20	12	48
5	0	00	0	00	0	00	0	00	0	00	11	25	1	00	2	00	2	10	0	00	5	10	12	51
6	0	00	0	00	0	00	0	00	0	00	11	28	0	00	0	00	1	00	0	00	1	00	12	54
7	0	00	0	40	0	00	0	00	0	40	11	31	0	00	0	00	0	00		00	0	00	12	56
8	0	00	1	00	2	60	0	00	3	00	11	33	0	00	0	00	1	00	0	00	1	00	12	59
9	0	00	0	00	0	00	0	00	0	00	11	36	0	00	0	00	0	00	0	00	0	00	13	02
10	0	00	0	00	1	00	1	30	2	30	11	39	0	00	0	00	0	00	0	00	0	00	13	04
11	0	00	0	00	0	00	0	00	0	00	11	42	0	00	0	00	0	00	0	00	0	00	13	08
12	0	00	0	00	0	00	0	00	0	00	11	45	0	00	0	00	0	00	0	00	0	00	13	11
13	0	00	2	10	2	15	0	45	5	10	11	48	0	00	2	10	3	00	1	30	6	40	13	13
14	0	00	0	00	0	00	0	00	0	00	11	51	0	00	0	00	0	00	0	00	0	00	13	16
15	0	00	0	00	0	00	0	00	0	00	11	53	0	00	0	00	0	00	0	00	0	00	13	17
16	0	00	0	00	0	00	0	00	0	00	11	56	1	40	3	00	3	00	1	45	9	25	13	21
17	1	20	3	00	3	00	2	00	9	20	12	00	0	40	3	00	3	00	0	00	6	40	13	24
18	1	00	3	00	0	00	0	00	4	00	12	03	2	00	3	00	3	00	2	30	10	30	13	27
19	1	10	3	00	1	00	0	00	5	00	12	05	1	20	3	00	1	10	0	00	5	30	13	30
20	0	00	3	00	2	00	1	00	6	00	12	08	0	00	0	00	0	00	0	00	0	00	13	33
21	0	00	0	00	0	00	0	00	0	00	12	11	0	00	2	15	3	00	0	00	5	15	13	35
22	1	30	3	00	3	00	2	15	9	45	12	14	0	00	0	00	2	00	1	10	3	10	13	38
23	0	00	0	00	1	00	0	00	1	00	12	16	0	30	1	00	2	10	0	00	3	40	13	40
24	0	00	0	00	0	00	0	00	0	00	12	19	1	00	3	00	3	00	1	20	8	20	13	43
25	0	00	1	00	1	00	0	00	2	00	12	22	0	00	0	00	0	00	0	00	0	00	13	45
26	0	30	2	00	0	00	0	00	2	30	12	25	0	00	3	00	3	00	0	00	6	00	13	48
27	1	20	3	00	3	00	1	40	9	00	12	27	0	00	0	00	0	00	0	00	0	00	12	50
28	1	30	3	00	3	00	1	30	9	00	12	30	0	00	0	00	2	00	0	00	2	00	13	54
29	0	00	0	00	0	00	1	00	1	00	12	33	1	00	3	00	1	30	0	00	5	30	13	56
30	0	00	2	00	2	00	0	00	4	00	12	36	1	00	3	00	3	00	0	00	7	00	13	59
31	1	00	3	00	2	15	0	00	6	15	12	39	……..		……..		……..		……..		……..		……..	
Total hours	10	20	37	50	30	30	13	20	92	00	370	10	11	00	36	25	43	55	10	50	102	10	401	13
Per cent. of possible	11.8		40.7		32.8		13.8		24.9		……..		10.9		40.5		48.6		9.8		25.5		……..	

SUNSHINE RECORD — (*Continued*).

DATE.	MAY.												JUNE.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours		Hours sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total hours.		Hours sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	0	00	0	00	0	00	0	00	0	00	14	06	1	35	3	00	3	00	1	45	9	20	15	05
2	0	00	0	00	0	00	0	00	0	00	14	08	1	20	3	00	3	00	1	20	8	40	15	06
3	0	00	0	00	0	00	0	00	0	00	14	11	1	40	2	15	3	00	1	00	7	55	15	08
4	0	00	0	00	0	00	0	00	0	00	14	13	2	00	3	00	3	00	1	20	9	20	15	09
5	0	00	0	00	0	00	0	00	0	00	14	15	0	40	2	10	3	00	0	00	5	50	15	10
6	0	00	0	00	0	00	0	00	0	00	14	17	0	00	0	00	0	00	0	00	0	00	15	11
7	1	20	3	00	3	00	1	40	9	00	14	20	2	00	3	00	3	00	2	00	10	00	15	12
8	1	40	3	00	3	00	1	15	8	55	14	22	2	05	3	00	3	00	1	50	9	55	15	13
9	1	30	3	00	3	00	2	00	9	30	14	25	1	00	2	10	2	10	1	20	6	40	15	14
10	1	25	3	00	3	00	1	40	9	05	14	27	0	00	3	00	2	40	1	40	7	20	15	15
11	1	35	3	00	3	00	1	50	9	25	14	29	0	00	0	00	1	00	0	00	1	00	15	15
12	1	40	3	00	3	00	1	50	9	30	14	31	2	00	3	00	3	00	2	15	10	15	15	16
13	1	20	3	00	3	00	1	15	8	35	14	33	1	40	2	10	3	00	1	30	8	20	15	16
14	0	00	1	00	0	40	0	00	1	40	14	35	0	40	3	00	2	10	1	10	7	00	15	16
15	0	00	0	00	0	00	0	00	0	00	14	37	0	00	2	00	2	00	1	00	5	00	15	17
16	0	00	0	00	0	00	0	00	0	00	14	39	2	10	3	00	0	00	0	00	5	10	15	18
17	0	00	0	00	0	00	0	00	0	00	14	41	2	00	3	00	0	00	0	00	5	00	15	17
18	0	00	0	00	0	00	0	00	0	00	14	43	0	00	0	00	2	10	2	00	4	10	15	17
19	1	20	3	00	3	00	1	30	8	50	14	45	2	10	3	00	3	00	1	40	9	50	15	17
20	1	35	3	00	3	00	0	40	8	15	14	47	2	10	3	00	3	00	1	50	10	00	15	17
21	1	45	3	00	3	00	2	10	9	55	14	49	0	00	0	00	0	00	0	00	0	00	15	17
22	2	00	3	00	3	00	1	10	9	10	14	51	0	00	0	00	0	00	0	00	0	00	15	17
23	1	20	3	00	1	40	0	00	6	00	14	52	2	20	3	00	3	00	2	00	10	20	15	17
24	1	40	2	10	1	10	0	00	5	00	14	54	2	15	3	00	3	00	1	10	9	25	15	17
25	2	00	1	15	1	10	0	40	5	05	14	56	2	10	3	00	3	00	2	10	10	20	15	16
26	0	00	2	10	2	00	0	00	4	10	14	57	0	00	0	00	0	00	0	00	0	00	15	16
27	0	00	0	00	0	00	0	00	0	00	14	58	0	00	0	00	1	20	0	00	1	20	15	15
28	1	00	2	00	3	00	0	00	6	00	15	00	2	15	3	00	3	00	2	10	10	25	15	15
29	1	40	3	00	3	00	1	40	9	20	15	01	2	10	3	00	3	00	2	15	10	25	15	15
30	1	00	3	00	3	00	2	00	9	00	15	03	0	00	0	00	0	40	1	30	2	10	15	15
31	1	00	3	00	3	00	1	30	8	30	15	04	....		....		....		....		....		....	
Total hours	26	50	53	35	51	40	22	50	154	55	453	29	36	20	61	45	62	10	34	55	195	10	457	23
Per cent. of possible	19.9		57.6		55.6		17.3		34.2		....		26.3		68.6		69.1		25.2		42.7		....	

SUNSHINE RECORD — (*Continued*).

DATE.	JULY.												AUGUST.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total.		Hours sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total.		Hours sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1.	2	10	3	00	3	00	1	40	9	50	15	13	2	00	3	00	3	00	1	40	9	40	14	26
2.	1	45	3	00	3	00	2	00	9	45	15	12	2	05	3	00	3	00	1	30	9	35	14	24
3.	0	00	0	00	0	00	0	30	0	30	15	12	1	50	3	00	3	00	1	20	9	10	14	22
4.	2	00	3	00	3	00	1	50	9	50	15	11	2	10	3	00	3	00	2	05	10	15	14	20
5.	0	00	0	00	0	00	0	00	0	00	15	10	2	15	3	00	3	00	2	40	10	55	14	17
6.	0	00	0	00	0	00	0	00	0	00	15	09	2	00	3	00	3	00	2	20	10	20	14	15
7.	2	00	3	00	3	00	1	20	9	20	15	08	1	10	3	00	2	00	1	00	7	10	14	13
8.	0	00	0	00	0	00	0	00	0	00	15	07	2	30	3	00	3	00	2	00	10	30	14	11
9.	1	50	3	00	3	00	1	40	9	30	15	06	2	40	3	00	3	00	3	10	11	50	14	08
10.	2	00	3	00	3	00	1	50	9	50	15	05	2	50	3	00	3	00	3	00	11	50	14	06
11.	1	30	3	00	3	00	1	10	8	40	15	04	2	20	3	00	3	00	2	40	11	00	14	03
12.	0	00	0	00	0	00	0	30	0	30	15	03	0	00	0	00	0	00	0	30	0	30	14	01
13.	0	00	0	30	0	00	0	00	0	30	15	01	3	00	3	00	3	00	3	10	12	10	13	59
14.	0	00	0	40	0	00	0	00	0	40	14	59	2	00	3	00	3	00	2	00	10	00	13	55
15.	1	00	3	00	1	20	0	00	5	20	14	58	2	40	3	00	3	00	2	50	11	30	13	53
16.	1	10	3	00	0	00	0	00	4	10	14	56	2	50	3	00	3	00	3	00	11	50	13	50
17.	0	00	2	10	3	00	1	10	6	20	14	55	0	00	0	00	0	00	0	00	0	00	13	48
18.	1	55	3	00	3	00	1	20	9	15	14	54	0	00	0	00	0	00	1	00	1	00	13	47
19.	2	00	3	00	3	00	2	05	10	05	14	52	2	40	3	00	3	00	2	10	10	50	13	45
20.	2	10	3	00	3	00	2	00	10	10	14	50	3	00	3	00	3	00	3	00	12	00	13	43
21.	2	10	3	00	2	30	1	20	9	00	14	48	0	00	1	20	0	00	1	20	2	40	13	40
22.	2	20	3	00	3	00	0	00	8	20	14	46	2	00	3	00	3	00	2	15	10	15	13	38
23.	1	40	3	00	3	00	1	30	9	10	14	45	2	10	3	00	2	15	1	40	9	05	13	35
24.	0	00	2	10	3	00	2	10	7	20	14	43	0	00	0	00	0	00	0	00	0	00	13	33
25.	0	00	1	10	1	10	0	00	2	20	14	41	0	00	0	00	0	00	0	00	0	00	13	30
26.	1	00	3	00	0	00	0	00	4	00	14	39	1	20	2	40	2	10	1	10	7	20	13	27
27.	2	00	2	50	1	45	2	00	8	35	14	37	1	40	0	00	0	00	0	00	1	40	13	25
28.	0	00	3	00	1	20	0	00	4	20	14	35	0	00	0	00	0	00	0	00	0	00	13	22
29.	0	00	0	00	3	00	1	50	4	50	14	33	0	00	0	00	0	00	0	00	0	00	13	19
30.	2	20	3	00	3	00	2	10	10	30	14	31	2	10	3	00	3	00	2	50	11	00	13	16
31.	1	00	0	00	0	00	0	00	1	00	14	28	2	00	3	00	3	00	2	40	10	40	13	13
Total hours.	34	00	63	30	56	05	30	05	183	40	462	11	51	20	67	00	63	25	53	00	234	45	428	47
Per cent. of possible	25.1		68.3		60.3		21.3		39.7		....		43.2		72.0		68.2		43.2		54.7		....	

SUNSHINE RECORD — (*Continued*).

DATE.	SEPTEMBER.												OCTOBER.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total.		Hours sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m.
1	2	35	3	00	3	00	2	45	11	20	13	08	1	45	3	00	3	00	2	00	9	45	11	43
2	2	10	3	00	3	00	2	10	10	20	13	05	1	50	3	00	3	00	1	55	9	45	11	40
3	0	00	0	00	0	00	0	00	0	00	13	02	1	55	3	00	3	00	1	45	9	40	11	38
4	2	00	3	00	2	10	1	40	8	50	13	00	0	00	0	00	0	00	0	00	0	00	11	35
5	2	10	2	40	2	00	1	20	8	10	12	57	1	20	2	10	0	00	0	00	3	30	11	32
6	2	00	2	20	2	15	1	40	8	15	12	54	0	00	1	20	0	00	0	00	1	20	11	30
7	0	00	0	00	0	00	0	00	0	00	12	51	1	30	3	00	3	00	1	40	9	10	11	27
8	0	00	1	00	1	20	0	00	2	20	12	49	1	50	3	00	3	00	1	45	9	35	11	24
9	1	20	2	00	3	00	2	00	8	20	12	46	1	00	3	00	3	00	1	20	8	20	11	21
10	1	10	2	10	2	00	0	00	5	20	12	43	1	25	3	00	3	00	1	40	9	05	11	18
11	1	15	0	00	3	00	1	10	5	25	12	40	1	15	3	00	3	00	1	55	9	10	11	15
12	2	00	3	00	2	40	1	20	9	00	12	38	1	20	3	00	3	00	2	00	9	20	11	13
13	0	00	0	00	0	00	0	00	0	00	12	35	0	00	0	00	0	00	0	00	0	00	11	10
14	0	00	0	00	0	00	0	00	0	00	12	32	0	00	1	10	2	50	1	00	5	00	11	07
15	0	00	0	00	0	00	1	00	1	00	12	28	0	00	0	00	0	00	0	00	0	00	11	04
16	0	00	1	20	0	40	0	00	2	00	12	26	0	20	0	00	1	35	2	30	4	25	11	01
17	1	00	0	00	0	00	0	00	1	00	12	23	2	00	3	00	3	00	2	30	10	30	10	58
18	0	00	0	00	1	20	0	00	1	20	12	20	1	50	3	00	3	00	2	00	9	50	10	55
19	1	10	2	10	2	40	1	15	7	15	12	17	1	30	0	00	0	00	1	10	2	40	10	52
20	0	00	1	30	2	10	1	10	4	50	12	14	1	30	3	00	2	55	0	20	7	45	10	50
21	1	30	3	00	3	00	1	00	8	30	12	12	1	50	3	00	2	10	0	10	7	10	10	47
22	0	00	2	10	3	00	1	10	6	20	12	09	2	00	3	00	3	00	1	00	9	00	10	45
23	0	00	1	20	2	10	0	00	3	30	12	06	0	00	0	00	0	00	0	00	0	00	10	42
24	1	10	2	10	1	20	0	00	4	40	12	03	1	10	1	20	3	00	1	00	6	30	10	37
25	0	00	0	00	0	00	0	00	0	00	12	01	1	15	3	00	1	10	0	00	5	25	10	36
26	1	40	3	00	1	10	0	00	5	50	11	58	1	00	2	10	0	00	0	00	3	10	10	34
27	1	40	3	00	2	20	1	10	8	10	11	55	0	00	0	00	0	00	0	00	0	00	10	32
28	0	00	0	00	0	00	0	00	0	00	11	51	0	00	1	20	0	00	0	00	1	20	10	29
29	0	00	0	00	1	40	1	00	2	40	11	49	0	45	1	00	0	50	0	00	2	35	10	26
30	1	40	3	00	3	00	1	40	9	20	11	46	1	10	2	00	0	00	0	00	3	10	10	24
31	....		....		....		....		....		....		2	00	3	00	3	00	1	40	9	40	10	21
Total hours	26	30	44	50	48	55	23	30	143	45	373	38	33	30	60	30	53	00	29	20	176	50	341	49
Per cent. of possible	26.5		49.8		54.4		24.8		38.5		....		38.9		65.1		57.5		41.1		51.7		....	

SUNSHINE RECORD — (*Concluded*).

DATE.	NOVEMBER.												DECEMBER.											
	Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total.		Hours, sunrise to sunset.		Before 9 A. M.		9 to 12.		12 to 3.		After 3 P. M.		Total.		Hours, sunrise to sunset.	
	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m	Hrs.	m	Hrs.	m.	Hrs.	m.	Hrs.	m.	Hrs.	m	Hrs.	m	Hrs.	m.	Hrs	m.
1	1	40	0	40	1	10	0	00	3	30	10	19	0	00	1	30	1	10	0	00	2	40	9	17
2	0	00	2	40	1	00	0	00	3	40	10	16	0	00	1	20	0	50	0	00	2	10	9	16
3	1	00	3	00	3	00	1	00	8	00	10	14	0	00	0	00	0	00	0	00	0	00	9	15
4	0	00	0	00	0	00	0	00	0	00	10	12	0	00	3	00	3	00	0	30	6	30	9	14
5	1	50	3	00	3	00	1	30	9	20	10	10	0	00	0	00	0	00	0	00	0	00	9	13
6	1	40	2	30	3	00	2	00	9	10	10	08	0	00	2	00	1	20	0	00	3	20	9	11
7	1	45	3	00	3	00	1	40	9	25	10	05	0	00	1	20	1	00	0	00	2	20	9	10
8	0	00	0	00	0	00	0	00	0	00	10	02	0	00	1	10	0	00	0	00	1	10	9	10
9	1	00	2	10	0	00	0	00	3	10	10	00	0	00	0	00	0	00	0	20	0	20	9	09
10	0	00	2	40	1	10	0	00	3	50	9	57	0	00	0	00	0	00	0	00	0	00	9	08
11	0	00	1	15	1	20	1	00	3	35	9	55	0	00	0	00	0	00	0	20	0	20	9	07
12	0	00	0	00	0	00	0	00	0	00	9	53	0	00	0	00	0	00	0	00	0	00	9	06
13	0	00	0	00	0	00	0	00	0	00	9	50	0	00	0	00	0	00	0	00	0	00	9	06
14	0	00	0	00	0	00	0	00	0	00	9	48	0	00	0	00	0	00	0	20	0	20	9	06
15	0	50	2	10	2	00	0	00	5	00	9	46	0	00	0	00	0	00	0	00	0	00	9	06
16	0	00	1	15	2	40	1	00	4	55	9	44	0	00	0	00	0	00	0	00	0	00	9	05
17	0	00	0	00	0	00	0	00	0	00	9	42	0	00	0	00	0	00	0	00	0	00	9	05
18	0	30	2	00	1	35	1	10	5	15	9	39	0	00	1	00	0	40	0	00	1	40	9	05
19	0	00	0	00	0	00	0	00	0	00	9	38	0	00	0	00	0	00	0	00	0	00	9	04
20	0	00	1	00	0	00	0	00	1	00	9	36	0	00	0	00	2	00	0	00	2	00	9	04
21	0	00	0	40	0	00	0	00	0	40	9	34	0	00	0	00	0	00	0	00	0	00	9	04
22	0	00	3	00	0	00	0	00	1	00	9	32	0	00	0	00	0	00	0	10	0	10	9	04
23	0	00	0	00	0	00	0	00	0	00	9	30	0	00	1	10	1	40	0	00	2	50	9	04
24	0	00	0	45	0	00	0	00	0	45	9	29	0	00	0	00	0	00	0	00	0	00	9	05
25	0	00	1	20	2	10	1	30	5	00	9	27	0	00	0	00	0	00	0	20	0	20	9	05
26	0	00	0	00	0	00	0	00	0	00	9	25	0	00	0	00	0	00	0	00	0	00	9	05
27	0	00	0	00	0	00	0	00	0	00	9	24	0	00	0	00	0	00	0	00	0	00	9	06
28	0	00	1	00	0	00	0	00	1	00	9	23	0	00	0	00	1	10	0	00	1	10	9	06
29	0	00	1	10	2	20	0	50	4	20	9	20	0	00	0	00	0	00	0	00	0	00	9	07
30	0	00	1	20	1	50	1	00	4	10	9	19	0	00	1	20	0	00	0	00	1	20	9	07
31	....		....		....		....		....		....		0	00	1	50	1	20	0	00	3	10	9	08
Total hours	10	15	34	35	29	15	12	40	86	45	293	17	0	00	15	40	14	10	2	00	31	50	283	01
Per cent. of possible	15.9		38.4		32.5		25.5		29.6		....		0.0		16.8		15.2		4.3		11.2		....	

MONTHLY SUMMARY OF SUNSHINE RECORD, MAY 1, 1885, TO JANUARY 1, 1894.

		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1885	Hours	......	......	......	......	165.2	237.5	284.7	163.5	206.7	134.5	53.2	50.0
	Per cent. of possible	......	......	......	......	36.4	52.0	53.8	38.1	55.3	39.3	18.1	17.6
1886	Hours	43.3	80.0	83.3	144.8	235.8	252.2	243.3	240.2	200.3	142.8	102.0	68.5
	Per cent. of possible	14.3	26.7	22.3	36.3	51.9	54.2	52.6	56.0	56.7	41.8	34.8	24.2
1887	Hours	44.0	61.5	110.7	159.0	265.0	217.8	267.5	235.8	......	......	......	......
	Per cent. of possible	14.5	18.2	29.7	39.9	58.4	47.6	57.9	55.0	......	......	......	......
1888	Hours	......	......	......	......	......	207.2	270.7	200.8	157.1	......	......	......
	Per cent. of possible	......	......	......	......	......	45.7	58.9	46.8	42.1	......	......	......
1889	Hours	65.8	84.6	124.4	164.7	185.2	158.6	255.3	234.2	152.0	106.8	65.4	62.3
	Per cent. of possible	22.4	28.6	33.6	41.0	40.8	34.7	55.2	54.6	40.7	31.3	22.3	22.0
1890	Hours	45.2	64.2	97.0	209.2	150.2	230.8	283.7	194.5	157.2	77.6	64.4	34.3
	Per cent. of possible	15.4	22.3	24.6	52.1	33.1	50.5	61.4	45.4	42.0	22.7	21.9	12.1
1891	Hours	77.8	96.8	155.8	150.7	139.7	220.6	240.2	223.7	220.5	187.6	83.2	104.6
	Per cent. of possible	26.5	32.7	42.1	33.4	30.8	48.6	52.0	52.1	59.0	54.9	28.4	37.0
1892	Hours	72.7	98.2	158.1	170.7	142.1	199.4	273.9	190.6	206.5	143.7	41.6	27.5
	Per cent. of possible	24.7	33.7	42.7	42.5	31.3	43.6	59.3	44.4	55.3	42.1	14.2	9.7
1893	Hours	58.9	50.0	92.0	102.2	154.9	195.2	183.7	234.8	143.8	176.8	86.8	31.8
	Per cent. of possible	20.0	16.9	24.8	25.5	34.2	42.7	39.7	54.8	38.5	51.7	29.6	11.2

Reading of Maximum and Minimum Thermometers at 7 A. M.

1893.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October		November.		December.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1......	29.6	11.0	27.5	18.0	34.4	20.0	62.0	25.0	59.0	42.2	73.0	44.0	81.0	54.0	87.6	62.0	73.0	54.6	60.0	37.0	44.0	40.0	45.5	30.0
2......	41.0	27.3	37.2	17.0	36.0	19.0	3 .0	24.0	60.0	48.0	72.4	51.4	84.0	58.0	74.2	57.0	60.8	40.6	59.5	40.6	58.0	42.0	33.0	17.0
3......	18.0	7.0	36.0	13.5	29.6	17.0	65.0	36.0	46.0	63.0	72.0	57.0	85.0	62.0	76.0	54.0	70.0	49.3	67.0	45.0	62.2	44.0	27.7	18.0
4......	17.5	10.0	41.0	4.5	34.0	18.0	70.4	31.0	55.0	42.0	73.6	60.2	79.0	54.0	84.0	61.0	72.0	52.0	74.0	48.0	52.0	42.5	42.0	17.3
5......	18.0	9.8	12.0	-1.0	24.0	9.0	47.0	26.5	44.8	39.3	84.0	65.0	77.0	56.4	89.0	58.0	80.0	53.0	60.0	48.4	39.6	31.0	25.0	4.0
6	22.0	12.0	27.5	18.0	25.0	12.6	39.0	22.0	49.3	39.0	83.5	61.0	81.0	58.0	68.0	54.8	62.3	49.0	68.0	48.0	43.0	31.3	31.0	8.0
7......	17.8	9.0	31.8	16.0	39.0	18.7	44.0	32.0	51.0	42.0	86.0	67.0	74.6	56.0	70.0	57.0	62.2	49.0	63.3	51.0	51.2	30.0	34.0	21.0
8......	23.0	9.0	26.0	2.0	38.0	22.0	74.0	34.0	51.0	40.0	72.0	50.0	83.3	64.0	81.5	56.5	65.0	49.0	66.0	42.0	53.0	31.0	31.0	10.5
9......	17.6	8.7	42.0	25.4	45.2	22.0	43.4	32.0	56.0	35.0	69.2	49.2	90.0	60.0	91.3	63.6	61.0	44.0	68.5	45.0	52.0	38.0	30.6	14.0
10......	24.0	2.5	28.0	6.0	37.0	27.0	45.0	28.0	64.6	39.2	78.0	54.0	71.0	52.0	93.0	65.0	73.0	49.0	72.2	39.5	49.0	26.8	42.0	29.0
11......	6.0	-6.0	17.0	4.2	42.0	27.4	56.0	28.0	69.0	46.0	84.0	60.0	71.6	49.0	94.5	68.0	75.0	48.0	61.6	38.3	50.0	27.2	39.0	13.0
12.....	11.0	-2.0	40.0	13.0	41.0	34.2	50.6	42.0	75.0	46.4	82.0	57.0	80.0	59.0	72.0	55.0	73.2	53.5	74.0	42.7	52.8	33.0	38.6	12.6
13	10.0	1.0	44.0	26.0	43.4	31.6	75.3	34.0	81.8	51.6	8 .0	52.8	76.0	63.3	67.0	49.0	67.8	55.4	76.0	52.5	54.0	36.0	31.0	6.5
14......	12.0	4.0	50.7	22.0	38.4	28.0	39.0	30.0	83.0	48.0	73.0	55.0	80.0	63.0	75.4	51.6	72.5	58.2	68.1	52.8	54.0	34.6	14.0	1.5
15......	10.0	-2.0	47.4	22.0	42.6	17.0	34.0	28.0	72.0	51.0	79.5	57.0	80.0	65.4	82.6	54.6	74.6	64.5	62.5	41.8	47.0	32.0	30.6	13.0
16......	9.0	-.7	42.7	27.4	19.0	10.0	40.0	29.0	61.0	49.6	83.0	57.0	89.3	67.3	88.0	60.0	70.0	54.0	60.3	35.6	39.0	24.0	49.8	16.0
17......	13.0	-4.0	32.2	4.0	35.0	11.2	55.0	32.4	71.8	53.0	86.8	61.0	87.0	67.0	77.0	60.0	62.7	48.0	45.1	30.1	35.4	26.0	54.0	23.0
18......	17.0	-3.0	18.0	2.0	22.0	10.0	49.0	30.0	60.4	45.0	83.5	60.0	87.0	65.0	75.3	55.2	63.5	46.5	64.1	42.0	54.0	34.6	23.5	11.5
19......	17.4	-2.0	21.0	16.0	31.0	15.0	48.0	30.0	52.0	45.0	82.6	62.0	79.3	61.0	78.0	57.0	68.7	52.0	64.0	41.0	37.6	28.0	35.0	13.0
20......	21.0	11.0	28.0	00.0	41.6	25.0	47.0	33.0	49.0	38.0	91.1	63.0	75.0	51.0	77.6	58.0	77.0	57.5	61.0	43.0	39.6	26.0	31.0	12.0
21	18.0	11.0	5.0	-.5	45.0	31.0	42.0	34.0	55.6	38.0	94.0	68.0	80.0	55.0	74.0	53.3	65.9	41.5	61.0	48.0	35.3	26.0	32.6	11.0
22......	22.0	4.0	21.0	1.0	33.0	24.0	59.0	35.0	76.7	45.0	86.3	65.0	87.3	66.0	77.3	55.0	64.7	48.4	67.0	45.0	39.7	28.0	41.3	32.3
23......	25.2	4.0	23.5	15.4	40.0	32.0	46.0	35.0	74.6	45.0	82.0	54.0	90.0	59.0	84.0	64.0	78.4	45.0	67.0	48.0	49.0	34.5	49.0	34.0
24......	30.0	21.0	29.0	16.0	54.0	32.0	46.4	34.0	75.6	53.0	74.0	54.2	71.0	48.4	72.0	62.0	61.2	44.5	61.0	54.0	38.2	28.0	55.6	37.0
25......	36.4	25.0	24.5	7.0	40.0	29.0	50.0	36.0	88.0	42.7	79.0	57.5	73.0	55.0	90.0	63.0	61.0	47.5	72.0	45.0	32.2	23.0	58.0	43.0
26......	34.0	21.0	33.0	17.0	34.2	23.0	47.0	25.0	62.0	43.7	78.0	57.0	95.5	62.0	81.5	63.0	69.1	37.4	50.0	33.0	31.7	23.0	62.0	14.0
27	40.0	16.0	31.0	6.0	37.8	19.0	55.4	29.0	77.6	39.0	73.0	57.0	87.5	56.0	82.0	65.0	57.5	39.5	54.0	35.0	30.0	19.0	24.0	13.0
28	20.0	9.0	29.6	6.2	26.0	16.0	53.0	39.0	57.0	46.0	68.0	52.6	70.0	50.0	84.0	66.0	64.0	38.5	55.0	40.0	47.5	29.0	35.0	19.0
29......	46.0	19.0	...	.....	40.4	20.2	61.2	40.0	63.0	44.0	72.2	52.0	79.0	60.0	71.4	49.0	62.0	39.0	54.5	32.0	48.0	33.4	46.3	32.0
30	36.0	19.0	......	......	44.0	32.0	61.2	38.6	60.0	39.0	77.0	54.8	82.0	59.0	71.3	50.0	54.4	40.0	42.7	30.5	48.0	34.3	39.5	15.0
31......	29.0	18.0	......	......	48.8	33.0	......	......	......	......	......	......	85.0	60.0	74.0	52.0	.....	......	41.7	25.0	.....	....	19.0	14.8
Avér.	22.3	8.7	29.5	11.6	36.8	22.1	51.4	39.7	63.5	44.7	79.1	57.2	81.0	58.6	79.5	58.0	67.6	48.3	62.0	41.9	45.6	30.8	37.1	17.9

READINGS OF THE

1893	JANUARY.			FEBRUARY.			MARCH.			APRIL.			MAY.			JUNE.		
	7. A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
1	28.6	32.0	38.2	26.0	21.0	22.0	21.5	32.3	30.0	47.3	58.0	47.5	49.0	53.0	57.0	58.4	67.6	68.0
2	38.0	33.3	27.8	17.0	16.0	15.0	22.0	29.0	26.0	25.0	30.0	31.0	60.0	62.0	54.6	65.0	68.0	68.4
3	15.0	14.0	35.0	36.0	35.0	23.0	24.0	27.4	32.0	37.0	58.0	55.0	48.0	52.6	50.0	67.0	82.0	75.0
4	12.0	8.0	11.0	4.5	26.0	21.0	19.0	23.6	17.6	50.0	70.4	56.0	42.0	43.0	42.0	69.7	80.7	79.0
5	17.0	11.0	15.0	2.0	22.0	19.0	13.0	23.0	20.4	33.0	45.0	36.4	42.4	44.4	47.0	72.6	84.0	80.0
6	17.0	16.0	13.3	31.8	36.0	34.0	19.0	30.6	28.4	27.0	31.3	30.0	43.0	49.0	49.0	69.0	70.0	69.0
7	16.0	21.8	14.8	6.5	18.5	26.0	35.0	36.0	32.4	34.0	34.0	37.0	43.2	54.0	53.4	57.6	67.0	67.0
8	12.0	10.3	17.3	34.5	39.0	27.2	23.0	41.6	40.0	44.0	59.0	58.0	43.0	61.0	58.0	59.0	76.0	75.0
9	18.0	21.4	23.0	16.0	13.0	6.5	37.0	36.5	34.0	36.7	42.0	41.0	48.0	67.0	66.4	62.0	82.4	79.4
10	3.0	-2.0	-5.0	14.4	8.5	13.5	28.2	39.4	37.0	34.4	43.0	42.0	56.4	72 0	67.0	74.0	80.0	71.4
11	-1.0	6.0	11.0	25.0	30.0	40.0	36.0	39.0	40.0	34.0	52.0	52.1	55.0	77.0	77.2	62.4	78.0	61.0
12	5.0	8.0	6.8	38.5	32.0	26.3	38.2	42.2	38.2	45.0	46.0	46.0	60.7	80.0	60.0	58.0	72.4	68.0
13	5.0	11.0	7.8	28.0	27.0	24.0	32.0	30.6	34.0	50.6	71.0	61.6	54.0	71.0	58.6	58.4	76.0	75.2
14	6.0	10.0	5.4	30.0	32.0	37.0	38.4	40.0	39.0	35.0	38.0	31.4	54.0	59.0	54.0	64.5	80.0	79.5
15	5.0	8.0	7.0	42.5	34.0	23.3	17.2	16.2	14.0	32.0	29 8	29.0	57.0	68.0	62.0	73.0	84.0	80.0
16	4.6	12.0	5.5	30.4	29.4	23.4	12.0	18.4	20.0	34.0	44.0	40.3	57.0	58.7	58.0	70.4	81.5	73.0
17	-1.0	12.5	7.0	4.5	11.4	13.0	18.0	30.0	29.3	35.0	52.0	44.0	46.7	51.0	49.2	63.5	79.0	74.0
18	3.0	11.8	16.4	17.0	19.0	16.8	16.0	19.3	17.0	35.6	46.6	43.6	45.7	47.0	49.0	73.4	86.2	81.2
19	14.0	20.0	15.5	18.0	26.6	26.0	26.0	35.0	37.5	34.0	46.4	39.2	43.4	50.4	55.0	72.8	89.0	83.5
20	12.0	15.0	14.5	1.0	4.0	17.7	32.0	30.8	26.4	37.3	36.5	39.0	46.0	70.3	67.4	73.5	90.5	85.0
21	14.0	18.8	10.4	3.5	12.0	17.4	33.0	35.6	35.4	41.0	54.0	47.0	66.7	70.4	67.5	73.0	82.6	74.0
22	5.0	21.0	22.0	16.3	17.0	19.5	40.0	48.0	52.0	38.4	44.0	39.4	54.0	69.0	73.6	69.0	82.0	70.0
23	28.0	28.0	26.0	20.5	26.0	25.0	35.0	39.2	31.0	37.4	46.0	42.8	71.2	85.6	63.0	60.0	70.0	70.2
24	32.0	29.0	33.0	16.0	20.0	18.0	29.0	33.0	31.0	37.0	46.0	48.0	46.0	57.0	58.0	65.6	67.7	73.3
25	28.8	25.8	22.5	17.7	32.0	23.5	27.0	35.4	31.8	37.6	42.4	42.0	56.0	76.6	54.0	60.0	75.0	74.0
26	32.0	34.0	16.5	21.0	28.0	20.0	20.4	26.0	22.5	30.0	45.0	52.3	48.4	56.0	50.4	60.0	65.0	63.0
27	14.4	10.0	20.0	8.0	29.0	19.2	20.5	33.7	36.0	41.4	50.0	49.0	50.0	61.0	61.0	58.6	65.0	65.0
28	35.0	34.0	36.0	25.4	32.0	33.0	37.8	37.6	40.4	46.0	59.0	54.0	50.0	57.0	57.0	59.6	66.2	69.0
29	33.0	30.0	20.0	.....	.....	.....	27.0	35.4	31.8	44.0	52.0	44.0	47.4	64.2	64.6	59.6	75.0	64.0
30	27.0	29.0	22.0	.....	.....	.....	37.8	37.6	40.4	45.0	57.0	47.0	54.0	70.0	62.7	77.7	75.0	64.0
31	24.0	30.0	28.0	.....	.....	.....	34.0	43.0	44.0	.....	.....	.....	52.0	70.0	67.0	....	....	....

STANDARD AIR THERMOMETER.

July.			August.			September.			October.			November.			December.		
7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
76.0	79.5	67.0	64.6	73.0	71.0	58.0	73.0	67.0	43.0	58.4	50.0	41.0	53.3	52.0	30.0	27.0	23.0
77.0	80.0	64.0	62.0	75.0	71.2	56.4	60.3	55.3	46.4	64.0	57.0	43.5	57.0	52.0	18.0	24.0	21.0
69.0	69.0	61 2	63.0	81.0	76.7	53.0	68.0	65.0	49.0	69.2	65.0	47.5	48.0	40.2	27.0	36.4	21.0
73.0	72.0	63.6	69.4	64.0	78.0	52.6	69.0	67.5	60.0	58.0	56.0	34.0	39.4	39.0	17.3	20.7	10.0
69.6	75.0	62.0	66.0	85.8	83.2	60.0	79.3	68.4	52.3	65.3	60.0	31.3	43.0	39.3	8.0	19.5	20.0
69.7	72.0	71.0	65.0	67.0	60.0	54.6	60.0	56.4	52.0	61.0	60.0	41.4	51.0	41.0	28.7	33.0	24.0
64.0	80.0	80.0	59.0	67.8	67.3	60.0	62.5	62.0	56.0	61.7	54.2	30.7	50.0	43.2	26.0	29.3	23.0
71.0	87.6	81.4	63.0	78.7	75.0	54.0	61.0	55.0	46.0	64.0	61.6	39.9	49.3	45.6	14.0	24.8	29.7
62.4	70.0	66.2	64.5	86.4	83.0	49.8	70.0	67.0	61.3	69.0	55.2	42.0	49.0	41.0	29.0	35.3	36.6
60.0	69.0	68.2	71.0	91.3	88.0	57.0	70.0	64.0	43.0	59.0	49.0	27.4	47.0	42.7	38.5	38.7	28.3
60.0	76.2	70.0	71.3	93.5	88.5	54.2	70.3	68.0	43.6	68.7	63.0	33.0	50.0	43.7	13.8	17.5	13.6
64.8	70.6	75.0	71.6	67.0	69.5	56.5	66.4	65.0	55.6	71.4	68.4	36.7	47.0	44.0	25.0	20.0	17.0
69.0	76.5	73.4	59.0	64.5	63.5	60.3	68.4	67.8	55.0	64.1	63.1	43.6	52.0	45.0	8.0	9.0	5.0
67.7	74.7	79.0	59.0	73.0	70.0	65.6	71.9	69.5	64.1	71.7	51.0	38.0	43.0	36.5	13.0	18.0	21.0
71.2	85.0	82.0	60.4	81.0	77.0	66.2	69.1	67.6	43.1	46.0	44.0	32.0	31.0	26.7	30.6	35.0	39.0
75.0	85.7	78.0	63.4	86.0	76.0	56.2	59.5	52.2	37.0	40.0	39.0	26.2	33.3	32.0	46.0	51.0	36.0
70.8	82.3	81.0	62.2	76.0	70.0	49.6	60.7	59.0	35.0	60.0	53.0	34.2	50.5	52.0	23.0	22.0	19.0
72.0	79.0	72.4	63.0	74.0	71.2	53.4	55.0	59.2	42.0	52.6	48.4	35.0	38.0	32.0	13.0	28.6	25.0
67.0	74.2	70.4	63.0	76.8	69.0	65.0	75.7	71.2	42.0	59.2	53.7	28.0	37.0	31.0	28.0	30.5	24.0
63.0	77.7	74.0	63.0	74.0	70.7	59.0	54.4	58.4	48.0	57.7	52.0	27.0	31.0	28.0	12.0	17.5	17.0
66.5	85.0	83.5	62.0	69.0	69.2	48.4	66.0	58.0	50.0	60.5	53.8	28.0	37.4	34.0	32.0	37.0	38.4
76.0	88.7	79.4	61.3	75.0	72.0	62.8	78.0	69.0	46.0	63.7	61.7	39.0	45.0	40.6	34.5	35.0	38.0
64.0	67.0	63.8	65.0	82.0	79.2	52.0	54.3	56.5	54.0	58.4	60.0	34.5	32.0	31.0	47.0	54.4	48.0
57.6	69.0	68.0	65.0	65.6	68.0	48.5	60.2	57.0	56.8	67.2	63.2	28.0	28.0	26.0	38.0	49.0	47.0
63.0	89.5	89.0	71.0	88.0	76.0	56.5	69.0	52.0	43.6	49.0	40.2	23.0	29.3	26.3	51.0	58.0	53.0
72.0	85.2	77.5	68.0	80.0	72.2	43.0	55.2	53.0	35.2	48.7	53.0	23.0	29.0	21.0	14.0	16.0	18.5
62.0	66.8	67.0	67.0	76.0	70.0	43.5	67.3	52.0	54.0	54.0	46.0	29.0	36.0	38.0	22.0	27.0	32.0
60.0	76.0	75.4	70.0	81.4	72.0	43.0	59.0	51.0	40.2	50.0	42.2	47.0	42.0	36.6	33.0	42.3	45.0
66.2	78.2	77.8	70.0	61.0	60.0	44.3	49.0	49.0	34.6	38.0	35.7	36.0	47.3	41.3	37.0	39.0	29.3
71.0	83.0	78.6	55.4	68.0	65.0	45.7	58.0	48.0	31.0	39.2	32.0	34.3	41.6	38.0	15.0	16.0	15.0
66.0	83.0	65.6	59.0	72.7	66.4	.....	.....	.....	26.0	43.0	38.2.	.....	.....	....	18.0	22.0	25.0

READING OF SOIL THERMOMETERS.

1893.	ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCHES.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M	12 M.	6 P. M.	7 A. M	12 M.	6 P. M.	7 A. M	12 M.	6 P. M.
May 1	48.4	50.0	52.6	48.3	49.6	52.2	48.2	48.0	51.6	47.5	47.7	49.6	46.6	46.5	47.4	50.0	50.2	50.4
2	52.0	56.2	55.8	51.6	55.7	55.4	51.0	55.3	55.2	49.8	53.5	53.2	47.4	48.2	50.4	51.2	52.0	52.1
3	49.5	53.0	52.7	49.6	52.4	52.7	50.0	51.6	52.7	50.0	50.2	51.4	50.4	50.2	49.2	52.5	52.5	52.5
4	47.3	48.6	47.0	47.6	48.7	47.4	48.0	48.7	48.0	48.2	48.4	48.2	48.2	48.0	47.7	52.6	52.5	52.3
5	44.2	46.2	48.0	44.5	46.5	48.2	45.2	46.6	48.0	46.0	46.4	47.4	46.2	46.0	46.5	51.7	51.5	51.3
6	44.5	49.6	49.0	44.5	49.3	49.0	45.2	48.4	49.2	46.0	47.0	48.6	46.0	46.0	47.0	51.3	51.0	51.0
7	45.0	52.0	56.0	45.4	51.8	54.6	45.7	47.0	54.0	46.0	46.8	51.6	46.2	46.3	48.7	51.2	51.3	51.4
8	45.5	55.4	57.6	45.7	54.2	56.5	46.2	52.7	55.6	47.0	49.6	53.0	47.2	47.5	49.8	52.0	52.0	52.2
9	47.4	57.7	60.0	47.5	56.5	58.8	48.0	54.7	57.8	48.5	51.2	55.0	48.5	48.7	51.3	52.8	52.9	53.2
10	50.4	60.0	61.5	50.3	58.8	60.7	50.7	57.2	60.0	50.7	53.2	57.3	50.2	50.8	53.5	53.8	54.2	54.2
11	52.4	59.4	63.5	52.5	58.7	62.0	53.8	57.2	60.8	52.7	54.6	57.6	52.0	52.3	54.2	55.4	55.5	55.8
12	55.0	61.2	61.5	55.2	60.6	61.2	55.0	59.2	60.7	54.6	56.2	58.6	53.6	53.7	55.4	56.6	56.6	56.8
13	54.2	59.6	59.0	54.3	59.0	58.6	54.4	58.0	58.4	54.5	56.0	57.0	53.9	53.8	54.6	57.2	57.2	57.2
14	56.5	57.0	55.0	56.5	57.2	56.0	56.0	56.2	55.6	55.0	55.2	55.2	53.6	53.8	53.7	57.2	57.2	57.2
15	53.2	59.3	61.0	53.2	58.6	60.5	53.4	57.6	60.0	53.3	55.0	57.8	52.6	53.1	54.6	57.0	57.0	57.0
16	56.0	57.3	57.0	56.1	66.2	56.0	56.0	57.0	56.0	55.5	55.7	55.6	54.6	54.2	54.5	57.6	57.7	57.6
17	51.5	53.0	52.7	51.3	53.2	53.2	52.6	53.2	53.3	53.2	53.0	53.2	53.3	52.6	52.6	57.6	57.5	57.2
18	50.6	52.0	52.2	50.6	52.2	52.4	51.7	52.6	53.0	52.0	52.2	52.6	52.0	51.6	51.8	56.8	56.6	56.5
19	47.0	53.4	56.6	47.6	52.5	56.6	48.6	52.0	56.2	49.6	51.0	54.5	50.3	50.3	52.0	56.0	55.7	55.6
20	47.8	59.0	60.2	48.3	57.5	59.5	49.5	56.0	58.8	50.0	52.8	56.4	50.7	51.0	53.4	56.0	55.9	56.0
21	56.5	65.5	62.1	56.3	63.3	61.7	56.0	61.5	61.7	55.0	57.6	60.0	53.7	54.5	56.7	57.0	57.4	57.9
22	53.0	65.4	67.2	53.2	62.6	66.0	53.6	60.6	64.4	54.4	57.2	61.0	54.5	54.6	57.2	58.5	58.4	58.7
23	61.3	68.5	63.3	61.0	66.6	63.0	60.2	65.0	63.0	58.6	61.0	61.6	57.0	57.6	59.0	58.7	59.6	60.0
24	51.2	60.4	63.0	52.0	58.9	62.4	53.4	58.6	62.0	55.0	56.6	60.0	55.6	55.3	57.2	60.2	60.2	59.8
25	53.5	64.2	61.2	53.6	61.7	60.8	54.0	60.2	60.8	54.5	57.2	59.6	55.0	55.2	57.2	59.8	59.8	60.0
26	51.2	60.2	56.5	51.7	59.0	56.4	52.4	58.4	56.5	53.7	56.2	56.1	54.2	54.5	55.3	59.7	59.6	59.7
27	53.4	58.5	59.5	53.5	57.7	59.5	53.8	56.7	58.6	54.0	53.0	57.0	54.0	54.0	55.0	59.4	59.0	58.8
28	51.6	57.2	59.5	52.2	57.0	59.2	53.0	56.6	59.0	53.7	55.4	58.2	54.1	54.2	57.6	58.9	59.0	58.7
29	51.2	64.0	64.5	51.5	61.0	63.5	52.0	59.4	62.7	52.6	56.0	60.0	53.4	57.0	56.5	58.9	58.6	59.0
30	54.5	64.5	65.0	55.0	61.7	64.3	55.0	60.5	63.7	55.2	57.3	61.2	55.2	55.3	57.7	59.5	59.5	59.8

Reading of Soil Thermometers — (*Continued*).

1893.	One Inch.			Two Inches.			Three Inches.			Six Inches.			Nine Inches.			Eighteen Inches.		
	7 A. M.	12 M.	6 P. M.	7 A. M	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M	7 A. M.	12 M	6 P. M	7 A. M.	12 M.	6 P. M	7 A. M	12 M.	6 P. M.
June 1	54.4	66.7	66.2	54.7	64.5	65.2	55.0	62.7	64.7	55.7	59.0	62.2	55.8	56.3	58.7	59.8	60.2	60.5
2	57.5	62.0	63.6	57.6	61.2	63.0	57.7	60.0	62.4	57.6	58.3	60.5	57.1	57.0	58.0	61.0	61.0	61.0
3	60.0	63.0	65.0	59.8	62.4	64.2	59.6	61.4	63.6	58.6	59.7	61.5	57.6	57.8	59.0	61.2	61.2	61.4
4	61.4	71.0	70.0	61.2	68.5	69.2	61.0	66.7	68.4	60.0	62.7	65.5	58.5	59.4	61.6	61.7	62.0	62.4
5	65.7	71.0	72.9	64.5	69.0	71.9	64.0	68.0	71.0	62.7	64.7	67.7	61.0	61.5	63.5	63.3	63.5	64.0
6	64.6	75.0	74.0	64.3	72.5	72.8	64.0	70.6	71.7	63.2	66.3	68.5	62.0	62.6	64.5	64.6	64.6	65.0
7	67.8	69.0	69.0	67.5	68.4	68.6	67.2	68.2	68.4	66.2	66.5	66.6	64.5	64.5	64.5	66.2	66.3	66.4
8	60.0	69.3	68.4	60.2	67.0	67.8	60.8	66.2	68.0	61.7	63.8	66.5	61.8	61.7	63.6	66.0	65.8	65.6
9	59.5	71.3	70.0	60.0	68.3	69.0	60.2	67.0	68.3	61.0	63.7	66.4	61.2	61.5	63.4	65.6	65.5	65.5
10	61.0	72.3	72.0	61.0	69.3	71.0	61.3	68.2	70.2	61.7	64.6	67.6	61.7	62.0	64.3	65.7	65.7	66.0
11	65.0	73.6	73.0	65.0	72.2	72.5	64.8	70.2	72.0	64.3	67.0	69.5	63.2	64.0	66.0	66.4	66.6	66.9
12	64.0	74.0	65.5	64.2	73.0	65.6	64.2	72.0	66.0	64.3	68.0	65.7	63.9	64.0	64.4	67.2	67.2	67.2
13	60.3	72.5	70.2	60.7	69.8	70.0	61.2	68.6	70.0	62.0	65.2	68.0	62.0	62.6	64.8	66.8	66.6	66.6
14	62.6	72.5	72.5	62.8	70.0	71.6	63.0	69.0	71.0	63.2	65.5	68.5	63.0	63.5	65.2	66.9	67.0	67.0
15	64.6	72.0	73.8	64.5	70.2	73.0	64.5	69.0	72.2	64.5	66.2	69.5	64.0	64.1	66.0	67.5	67.5	67.6
16	64.7	73.0	73.9	72.0	73.6	73.3	64.8	72.0	72.0	65.0	68.0	68.6	64.2	65.0	66.0	67.6	68.0	68.2
17	65.5	74.0	74.0	65.0	72.0	67.8	67.0	70.8	67.5	65.4	67.5	66.8	65.0	65.2	65.8	69.0	68.8	69.5
18	68.0	77.5	76.8	75.4	76.2	67.5	74.3	75.7	67.4	70.0	72.9	67.5	66.7	69.0	67.0	69.5	69.8	70.5
19	67.5	77.4	76.0	75.8	75.5	68.0	74.8	75.1	75.0	71.0	73.0	68.3	67.8	69.5	67.8	70.4	70.6	71.0
20	78.5	78.5	71.0	76.5	77.8	70.5	75.0	77.2	70.4	71.0	74.1	69.7	68.1	70.5	68.6	71.0	71.5	71.7
21	76.0	75.8	70.0	75.0	75.2	69.6	74.3	74.0	69.7	71.4	73.0	69.3	69.0	70.0	68.5	71.7	71.7	71.8
22	76.5	73.4	63.5	75.4	73.2	64.2	74.4	73.0	64.7	71.2	71.6	66.0	68.6	69.5	66.6	71.7	71.6	71.2
23	74.5	72.2	63.0	72.6	72.2	63.5	71.7	72.2	64.0	68.6	71.0	65.2	66.6	68.6	65.8	71.0	71.0	70.7
24	75.0	73.3	62.0	73.3	73.0	62.8	71.8	73.0	64.3	68.3	71.3	66.0	66.1	68.5	66.0	70.5	70.6	70.4
25	69.5	70.0	62.3	69.5	70.0	62.8	69.0	69.6	63.4	67.6	68.5	64.4	66.0	66.8	64.8	70.3	70.2	70.0
26	65.5	68.0	62.7	65.2	68.0	63.0	64.8	67.8	63.3	64.4	66.7	64.0	64.2	65.2	64.0	69.5	69.3	69.0
27	65.6	66.2	61.2	65.0	66.0	61.5	64.4	66.0	61.8	63.7	65.5	62.5	63.6	64.3	62.7	68.9	68.6	68.2
28	67.0	69.0	60.3	66.8	68.6	60.4	66.2	68.0	60.7	64.5	66.5	61.7	63.0	64.5	62.6	68.0	68.2	68.2
29	64.0	63.4	77.4	71.2	73.0	74.7	69.7	63.3	72.8	65.6	64.0	68.0	63.2	64.4	65.0	68.0	69.0	69.0
30	66.2	68.2	78.5	66.0	67.0	74.0	64.7	66.7	72.0	72.0	72.3	69.0	64.0	65.4	66.3	69.5	70.3	70.2

READING OF SOIL THERMOMETERS — (*Continued*).

1893.	ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCHES.		
	7 A. M	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M	7 A. M.	12 M.	6 P. M.	7 A M.	12 M.	6 P. M	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
July 1	65.5	75.2	78.0	65.2	74.4	76.0	65.7	74.0	74.4	66.5	72.0	70.2	66.6	69.0	67.2	70.5	70.8	70.8
2	65.5	76.2	68.7	65.5	75.6	68.0	66.3	75.0	67.6	67.5	72.6	67.0	67.6	69.6	66.5	71.0	71.5	71.0
3	62.0	72.0	75.5	62.0	71.6	73.2	62.7	71.4	71.7	64.4	69.7	67.7	65.3	67.6	65.5	70.9	70.6	70.3
4	63.6	75.0	68.3	64.0	74.2	67.8	64.4	73.7	67.2	65.5	71.3	66.0	66.0	68.2	65.4	70.5	70.8	70.5
5	64.6	70.5	74.0	64.6	70.0	72.3	65.0	69.6	70.8	65.2	68.0	67.7	65.3	66.4	65.6	70.2	70.2	70.1
6	64.5	72.5	75.3	71.8	72.2	75.5	71.5	71.6	74.6	68.2	69.8	72.0	65.9	67.6	68.6	70.3	70.2	70.5
7	69.9	76.3	79.5	69.7	78.4	75.6	69.6	76.6	75.0	69.0	72.0	72.7	68.9	68.6	70.0	71.3	71.5	71.9
8	66.2	76.2	74.5	66.4	73.2	72.5	66.8	72.2	72.6	67.6	69.6	71.5	67.7	67.8	69.4	72.0	71.9	71.9
9	62.5	73.0	73.4	62.4	71.7	73.0	63.2	70.7	72.7	64.9	68.0	71.2	66.0	66.2	68.6	71.5	71.2	71.2
10	61.4	73.5	74.2	61.5	72.4	72.3	62.3	71.3	72.2	64.4	67.8	70.8	65.6	65.8	68.4	71.2	71.0	71.0
11	65.2	73.0	69.4	65.4	69.0	71.6	65.8	68.4	71.0	66.5	67.3	69.0	66.6	66.4	67.1	71.3	71.1	71.0
12	67.5	72.3	75.6	67.3	74.3	74.8	67.2	72.7	74.6	67.3	69.2	73.6	66.7	67.2	69.6	71.1	71.2	71.6
13	68.9	75.5	76.0	66.8	74.2	74.4	68.8	73.0	74.3	68.8	69.3	72.5	68.3	68.2	68.6	72.0	72.1	72.0
14	64.6	76.0	74.0	69.0	75.0	73.3	68.9	73.1	72.6	69.0	69.4	70.0	68.2	68.2	68.3	72.0	72.1	72.0
15	70.0	78.0	77.2	70.0	76.8	76.6	69.8	75.2	76.0	69.5	71.5	74.0	68.7	69.0	71.1	72.5	72.5	72.8
16	71.3	81.0	71.9	71.2	79.0	78.6	71.2	77.8	78.2	70.6	73.5	76.0	69.7	70.4	72.6	73.2	73.3	73.6
17	71.1	76.0	77.2	71.2	75.0	76.7	71.4	74.1	76.0	71.3	72.0	74.2	70.7	70.4	71.8	74.2	74.0	74,0
18	70.4	76.5	76.7	70.4	75.2	76.3	70.4	74.2	76.2	70.5	71.9	76.6	70.2	70.3	70.8	74.2	74.0	74.0
19	67.6	76.5	76.0	68.0	75.5	75.7	68.6	74.6	75.6	69.4	71.6	74.3	69.6	69.8	71.8	74.0	74.0	74.0
20	64.0	75.4	76.2	64.2	74.0	75.6	65.1	73.0	75.2	67.0	70.0	73.5	68.2	68.3	71.0	73.8	73.3	73.4
21	65.0	76.5	79.0	65.1	75.1	77.4	65.7	74.0	76.6	67.0	70.5	74.2	68.0	68.4	71.0	73.4	73.1	73.4
22	68.5	75.6	75.6	68.6	75.0	75.3	68.8	74.2	74.2	69.4	71.5	73.0	69.5	69.6	71.0	74.0	73.7	73.8
23	67.3	72.6	71.1	67.2	72.0	71.2	67.7	72.1	71.6	68.6	70.2	71.5	68.8	68.9	70.0	73.6	73.3	73.2
24	61.3	71.0	73.5	62.0	70.0	72.8	62.7	69.4	72.4	67.4	67.2	70.8	66.2	66.2	68.6	72.6	72.0	72.0
25	63.5	72.7	77.3	64.0	71.7	76.7	64.6	70.5	75.4	67.5	67.7	72.4	67.3	66.5	69.3	72.0	71.9	72.0
26	70.0	75.0	76.0	69.8	74.0	75.5	75.5	73.0	75.0	75.0	70.5	73.2	78.8	68.8	70.6	72.7	72.7	73.0
27	65.0	71.0	72.2	65.3	69.8	71.6	66.0	69.9	71.6	67.5	68.6	71.0	68.0	67.7	69.2	73.0	72.8	72.6
28	62.0	69.6	69.4	62.5	69.0	69.0	63.2	68.6	69.0	65.0	67.1	68.6	66.0	66.1	67.5	72.1	71.8	71.6
29	66.0	73.0	75.7	66.0	71.9	75.0	66.0	70.8	74.2	66.3	68.3	72.0	66.3	66.6	69.3	71.5	71.5	71.9
30	66.0	75.2	77.5	66.2	73.9	76.5	66.0	73.0	75.8	66.3	70.0	73.6	66.4	67.8	70.4	71.6	72.2	72.6
31	66.9	74.0	73.2	67.2	73.0	73.0	67.4	72.0	73.3	68.0	69.8	72.2	68.3	68.3	70.0	73.0	72.8	72.7

READING OF SOIL THERMOMETERS — (*Continued*).

1893.	ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCHES.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
August 1	67.6	72.5	75.0	68.0	71.7	74.2	68.0	71.0	74.0	68.2	69.4	72.5	68.0	68.2	70.0	72.8	72.7	72.7
2	66.0	72.7	75.4	66.2	71.8	74.6	66.7	71.4	74.0	67.5	69.4	72.5	67.8	68.0	70.0	72.9	72.7	72.8
3	64.2	73.2	76.8	64.6	71.8	76.0	65.2	71.2	75.3	66.6	68.9	73.0	67.5	67.5	70.0	72.9	72.5	72.8
4	66.7	73.5	72.3	67.2	72.6	72.2	67.6	72.0	72.1	68.2	69.8	71.2	68.3	68.4	69.6	73.2	73.0	73.0
5	65.0	73.6	76.8	65.3	72.2	76.0	65.8	71.5	75.0	66.8	68.9	72.6	67.4	67.4	70.0	72.8	72.6	72.7
6	67.6	72.0	68.0	68.0	71.6	68.3	68.2	71.0	69.0	68.5	69.3	69.5	68.5	68.3	68.7	73.0	72.9	72.7
7	63.0	68.1	68.5	63.6	67.8	68.5	64.2	68.0	68.6	65.4	67.0	68.3	66.0	66.2	67.3	72.0	71.7	71.6
8	63.0	71.9	75.2	63.3	71.7	74.5	63.9	70.0	73.8	65.0	67.5	71.5	65.5	65.9	68.6	71.3	71.0	71.3
9	64.1	74.4	78.0	64.5	73.0	77.0	65.0	71.6	75.9	66.0	68.6	73.0	66.5	66.9	69.8	71.9	71.7	72.0
10	67.4	77.4	79.5	67.5	76.0	78.5	67.7	74.4	77.6	68.3	71.0	74.8	68.3	68.6	71.4	72.6	72.7	73.0
11	68.5	79.0	81.2	68.7	77.2	80.0	69.0	75.4	79.0	69.5	72.0	76.0	69.5	69.7	72.5	73.6	73.6	74.0
12	71.3	72.4	73.3	71.4	73.3	73.0	71.6	72.1	73.0	71.4	71.3	72.0	70.6	70.3	70.4	74.4	74.1	74.0
13	63.5	73.2	72.5	64.2	72.0	72.1	65.7	71.0	71.8	66.7	69.0	71.0	67.6	67.6	69.2	73.2	73.0	72.9
14	61.0	71.2	74.6	61.2	70.0	73.8	62.1	69.0	73.2	64.2	67.0	71.3	65.7	66.0	68.6	72.2	72.0	72.0
15	62.0	74.2	77.6	62.7	73.0	76.8	63.5	71.2	75.7	65.1	68.2	73.2	66.0	66.6	69.9	72.0	72.0	72.0
16	64.0	76.6	77.5	64.5	75.0	76.6	65.0	73.0	76.0	66.5	69.5	73.6	67.2	67.5	70.4	72.5	72.4	72.6
17	67.0	72.2	73.0	67.6	71.4	72.5	68.0	70.8	72.4	68.7	69.4	71.2	68.9	68.3	69.4	73.0	73.0	72.9
18	66.2	73.0	75.2	66.5	71.6	74.6	67.0	71.0	74.4	67.5	69.0	72.6	67.7	67.7	70.0	72.7	72.6	72.7
19	65.2	73.5	73.8	65.5	72.3	73.2	66.0	71.5	73.0	67.0	69.3	71.7	67.6	67.8	69.5	73.0	72.7	72.6
20	66.0	73.8	73.5	66.4	72.4	73.0	66.6	71.6	73.0	67.0	69.6	71.6	67.2	67.8	69.6	72.6	72.7	72.6
21	65.3	71.9	72.0	65.6	71.0	71.9	66.0	70.7	72.0	67.0	69.0	71.0	67.3	67.6	69.2	72.6	72.4	72.5
22	62.2	71.2	73.9	62.7	69.8	73.0	63.7	69.0	72.4	65.2	67.5	70.7	66.2	66.5	68.6	72.2	72.0	72.0
23	63.0	72.3	74.5	63.5	71.3	74.2	64.0	70.0	73.6	65.3	67.5	71.6	66.0	66.2	69.9	72.0	71.7	72.0
24	67.4	67.5	68.5	67.6	67.7	68.5	68.0	67.0	68.6	68.1	67.7	67.0	67.8	67.5	67.3	72.2	72.2	71.9
25	65.5	73.5	75.0	65.8	72.3	74.4	65.9	71.3	74.0	66.2	68.5	72.2	66.2	66.7	69.4	71.5	71.6	71.8
26	67.5	75.5	76.0	68.0	73.8	75.5	68.1	73.0	75.3	68.4	70.0	73.4	68.2	68.4	70.6	72.5	72.6	72.7
27	67.5	73.0	71.9	68.0	72.2	72.0	68.2	71.7	72.1	68.3	70.0	71.3	68.2	68.9	70.0	72.7	73.0	73.0
28	68.5	73.5	73.0	68.7	73.0	72.7	68.7	72.3	72.6	68.6	70.2	71.4	68.5	68.7	69.7	73.0	73.0	73.0
29	68.7	67.5	66.2	68.8	67.7	66.8	69.0	68.4	67.4	69.0	68.6	68.0	68.7	68.4	68.0	73.4	73.2	73.0
30	60.2	69.0	70.0	61.2	67.6	69.6	72.0	67.6	69.6	64.0	65.8	69.0	65.2	65.3	67.2	72.0	71.7	71.4
31	61.2	69.0	70.2	61.6	68.0	69.9	62.3	67.8	69.7	64.0	66.0	68.6	65.0	65.0	66.9	71.2	71.0	71.0

READING OF SOIL THERMOMETERS — (*Continued*).

1893.	ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCHES.		
	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M.	6 P. M.
September 1	62.0	67.6	65.5	62.5	67.3	66.0	62.7	67.0	66.0	64.0	65.5	66.2	65.0	64.9	65.6	71.0	70.7	70.6
2	61.0	65.2	64.0	61.5	64.8	64.3	62.3	65.2	64.8	63.5	64.4	65.5	64.1	64.0	64.9	70.2	70.1	69.9
3	56.2	63.2	62.0	57.2	63.2	63.3	57.8	60.0	63.4	60.0	61.0	63.5	61.7	61.8	62.7	69.7	69.0	68.6
4	59.0	65.0	67.5	59.5	64.0	67.0	60.0	63.8	66.6	61.2	62.4	65.5	61.8	62.0	63.7	68.3	68.3	68.3
5	61.0	69.0	68.9	61.4	67.6	68.5	61.7	67.0	68.4	62.5	64.3	67.0	62.7	63.0	65.0	68.5	68.6	69.0
6	61.8	68.2	66.7	62.4	67.1	66.6	63.0	66.7	66.6	63.7	64.6	66.5	64.0	63.8	65.2	69.2	69.2	69.2
7	59.4	61.5	62.0	60.0	61.7	62.0	60.6	62.0	62.1	61.6	62.0	62.1	62.5	62.3	62.1	69.0	68.6	68.2
8	59.5	66.2	65.6	60.0	65.3	65.5	60.3	64.8	65.7	61.4	62.8	63.6	61.7	62.0	63.6	68.0	68.0	68.0
9	55.8	66.0	65.2	57.0	65.0	65.0	58.0	64.3	65.0	60.0	64.2	62.0	61.2	61.3	62.7	68.0	67.8	67.6
10	59.8	69.0	68.4	60.2	67.7	68.0	60.7	66.8	68.0	61.5	63.8	66.7	61.7	62.3	64.6	67.7	67.9	68.0
11	59.2	66.3	67.8	60.0	65.4	67.0	60.5	65.0	65.5	62.0	63.2	65.6	62.6	62.5	64.0	68.5	68.4	68.2
12	59.3	63.0	61.9	59.9	62.8	62.0	60.5	62.8	62.2	61.8	62.3	62.7	62.5	62.1	62.5	68.3	68.2	68.0
13	60.5	63.8	65.4	60.7	63.5	65.2	61.0	63.2	65.0	61.5	62.3	64.0	61.5	61.8	62.8	67.5	67.5	67.5
14	63.8	66.7	67.0	63.9	66.3	66.8	63.7	65.8	66.6	63.5	64.5	65.6	63.0	63.2	64.0	68.0	68.0	68.2
15	65.5	66.2	67.2	66.5	66.0	67.0	64.5	65.7	66.9	64.8	64.9	67.0	64.0	64.5	68.5	68.6	68.6	68.8
16	62.0	62.9	60.6	62.7	63.3	61.4	63.4	63.4	62.0	64.0	63.5	63.1	63.7	63.4	63.2	68.8	68.8	68.5
17	56.5	60.3	60.5	57.3	60.3	60.8	57.8	60.3	61.0	59.5	60.0	61.4	59.8	60.4	61.0	67.5	67.3	66.8
18	56.5	57.7	58.5	57.3	58.0	58.7	57.6	58.4	57.8	58.8	59.0	59.2	59.7	59.4	59.5	66.5	66.3	66.0
19	61.5	66.5	68.0	62.3	65.5	67.3	61.2	64.8	66.8	60.5	62.4	65.0	60.0	60.8	62.6	65.8	66.0	66.4
20	62.3	65.7	64.8	62.5	65.2	64.8	62.8	65.0	64.8	63.2	63.6	65.8	62.8	62.7	63.6	67.3	67.5	67.5
21	56.6	62.9	62.6	57.5	63.4	62.4	58.3	62.0	62.4	60.0	62.0	62.4	61.1	60.8	61.7	67.3	67.2	66.8
22	59.0	63.5	65.0	59.4	62.8	64.8	59.5	62.4	64.6	60.2	61.0	63.4	60.5	60.5	61.9	66.6	66.5	66.5
23	56.5	58.0	58.3	57.2	58.6	58.6	58.0	59.0	59.0	59.5	59.6	59.5	60.5	60.2	59.9	66.6	66.4	66.0
24	55.0	60.0	60.0	56.0	60.2	60.2	56.5	59.8	60.3	57.8	58.0	60.3	58.7	58.0	59.5	65.5	65.7	65.2
25	57.5	61.1	58.0	58.0	61.0	58.5	58.0	60.6	59.2	58.6	59.7	59.8	59.0	59.0	59.5	65.2	65.2	65.0
26	51.3	56.0	57.5	52.5	56.3	57.3	52.3	57.3	57.6	55.6	56.2	57.7	57.4	58.0	57.6	64.5	64.3	64.0
27	50.6	57.5	58.6	51.8	57.2	58.5	52.5	56.8	56.9	55.0	55.8	58.0	56.0	56.0	57.2	63.5	63.3	63.0
28	51.5	56.3	56.4	52.5	56.4	56.5	52.4	56.9	53.0	55.0	56.0	57.0	55.2	55.0	56.0	62.5	62.4	62.2
29	51.2	53.7	55.5	52.0	54.0	55.6	52.4	54.2	55.8	54.2	54.5	56.0	56.2	56.2	57.0	63.0	63.0	63.0
30	50.4	57.0	56.0	50.5	56.6	56.4	51.0	56.8	56.0	53.5	55.0	57.0	54.3	55.0	56.3	62.0	62.0	62.0

READING OF SOIL THERMOMETERS — (*Concluded*).

1893.	ONE INCH.			TWO INCHES.			THREE INCHES.			SIX INCHES.			NINE INCHES.			EIGHTEEN INCHES.		
	7 A. M.	12 M.	6 P. M	7 A. M.	12 M.	6 P. M.	7 A. M.	12 M	6 P. M.	7 A. M.	12 M	6 P. M	7 A. M.	12 M.	6 P. M	7 A. M.	12 M.	6 P. M.
October 1	49.3	57.0	56.5	50.0	56.6	57.0	51.0	56.4	56.3	53.5	55.0	57.1	54.4	54.6	56.3	62.0	61.8	61.5
2	50.4	57.2	59.0	51.3	57.7	59.0	52.0	56.8	57.3	53.5	55.5	58.3	54.6	55.0	56.6	61.6	61.8	61.5
3	52.2	59.4	60.4	53.2	59.0	60.3	53.4	57.7	58.7	54.6	56.5	59.2	55.3	55.6	57.4	61.7	62.0	62.0
4	57.5	58.0	58.0	57.6	58.0	58.0	58.9	57.8	57.8	58.0	57.7	57.4	57.5	57.0	57.3	62.5	62.5	62.6
5	56.0	60.6	61.2	56.3	60.2	61.0	57.0	59.0	60.6	57.0	58.2	60.0	57.0	57.2	58.6	62.6	62.8	62.8
6	55.0	58.0	57.5	55.4	58.0	58.0	56.8	57.8	57.7	57.3	57.5	57.4	57.0	57.0	57.4	63.0	63.0	62.8
7	55.0	58.0	56.6	56.0	58.2	57.0	56.8	58.0	57.6	57.0	57.3	57.4	57.0	57.0	57.2	62.7	62.7	62.7
8	51.2	56.0	57.2	52.2	56.0	57.3	54.0	55.8	57.0	54.4	55.2	56.8	55.5	55.3	56.2	62.2	62.0	62.0
9	55.0	60.0	58.0	55.5	59.5	58.3	55.7	58.3	58.7	56.0	57.4	58.8	56.0	56.5	57.6	62.0	62.0	62.0
10	52.0	57.5	58.0	53.0	57.2	57.3	54.6	56.8	57.6	55.0	56.0	57.6	55.6	55.7	56.7	62.0	62.2	62.0
11	50.0	56.2	57.4	51.1	56.0	57.6	52.0	57.0	57.3	53.5	54.6	57.0	54.6	54.5	56.0	61.6	61.4	61.2
12	53.0	59.2	59.2	53.9	58.5	59.3	52.0	56.8	56.6	55.0	56.4	58.5	55.2	55.5	57.0	61.2	61.4	61.6
13	54.0	57.5	55.0	57.0	58.5	58.2	51.2	54.6	54.2	56.0	57.5	57.0	56.5	56.4	56.3	61.8	61.8	60.4
14	54.5	57.5	52.5	60.5	58.7	52.0	51.0	54.0	53.8	58.0	58.7	58.3	57.5	58.8	58.3	62.0	62.5	57.1
15	47.0	49.1	48.5	49.5	49.8	49.5	51.2	53.8	54.0	52.1	51.8	51.9	54.0	51.8	53.0	61.5	59.3	60.0
16	45.0	48.0	49.0	58.5	47.5	59.5	51.0	53.2	54.0	50.5	50.1	50.7	51.8	51.5	51.5	59.5	59.3	58.8
17	43.1	51.0	52.5	44.5	50.1	52.5	50.8	53.0	52.9	47.5	49.0	52.0	49.5	49.8	51.0	58.1	58.0	57.5
18	47.0	51.6	52.2	48.0	51.2	52.4	50.0	52.8	52.6	49.8	50.6	52.5	50.8	50.7	52.4	58.0	57.9	58.0
19	48.0	52.6	52.5	49.0	52.9	53.0	50.0	52.0	51.2	50.4	51.2	53.0	51.0	51.0	52.2	58.0	58.0	58.0
20	48.4	52.2	52.2	49.2	52.1	52.5	49.8	49.9	51.0	50.6	51.5	53.0	51.3	51.4	52.4	58.0	58.0	58.0
21	49.8	54.4	55.4	50.2	54.0	55.5	50.0	53.0	52.8	51.0	52.7	54.6	51.6	52.0	53.4	58.0	58.2	58.2
22	50.0	56.0	56.6	50.7	55.2	56.7	50.8	52.0	51.8	52.0	53.4	55.6	52.5	52.7	54.0	58.5	58.6	58.7
23	53.4	56.0	56.6	53.7	55.6	55.5	50.0	51.0	51.8	54.0	54.6	54.6	53.7	54.0	54.5	59.0	59.2	59.3
24	55.5	60.0	59.6	56.0	58.8	59.5	49.0	51.8	52.0	55.5	56.6	58.0	55.0	55.2	56.5	59.7	60.0	60.0
25	52.4	53.6	51.6	53.3	53.6	52.6	51.0	52.0	52.0	55.0	54.6	54.3	55.5	54.9	54.6	60.5	60.6	60.2
26	46.5	49.0	48.5	47.6	49.3	49.5	50.1	50.8	51.0	50.6	50.4	50.6	52.0	51.5	51.5	59.3	59.0	58.6
27	50.5	51.6	50.6	50.7	52.0	51.2	50.8	51.8	52.0	51.2	51.6	51.6	51.4	51.6	52.0	58.0	58.0	58.0
28	48.2	49.5	48.0	49.0	50.0	48.6	50.6	51.0	51.6	50.5	50.7	50.2	51.2	51.0	51.0	57.8	57.7	57.6
29	42.7	43.0	42.6	44.0	44.0	43.6	49.6	50.0	51.0	47.5	46.7	46.0	49.2	48.4	48.0	57.0	56.6	56.0
30	40.2	43.2	43.0	41.5	43.5	44.0	48.8	49.0	50.0	44.5	45.0	45.6	46.5	46.3	46.6	55.0	55.0	54.2
31	38.8	42.0	42.0	40.2	42.3	42.8	48.8	49.6	49.8	43.5	43.6	44.6	45.4	45.0	45.5	54.0	53.6	53.3

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  record for 1893 ... 720
Work of the Station and its needs ... 178

Y.

Yellow prussiate of potash, test for Bordeaux mixture ... 692, 706
Yield of apples in 1893 ... 603
  blackberries in 1893 ... 631
  cheese from 100 pounds of milk ... 460
  crab apples in 1893 ... 609
  dewberries in 1893 ... 634
  raspberries, black, in 1893 ... 639
    purple, in 1893 ... 643
    red, in 1893 ... 650
    white, in 1893 ... 655
    yellow, in 1893 ... 655
  strawberries in 1893 ... 673
  tomatoes in 1893 ... 592

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